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THE  
HONEY-BEE.



# THE HONEY-BEE.



“What well appointed commonwealths ! where each  
Adds to the stock of happiness for all ;  
Wisdom’s own forums ! where professors teach  
Eloquent lessons in their vaulted hall !  
Galleries of art ! and schools of industry !  
Stores of rich fragrance ! Orchestras of song !  
What marvellous seats of hidden alchymy !  
How oft when wandering far and erring long,  
Man might learn truth and virtue from the BEE !” — *Bowring.*



THE  
**H O N E Y - B E E ;**

ITS

NATURAL HISTORY, PHYSIOLOGY  
AND MANAGEMENT,

BY

EDWARD BEVAN, M.D.

---

“ A bee amongst the flowers in spring, is one of the cheerfullest objects that can be looked upon. Its life appears to be all enjoyment : so busy and so pleased.”

PALEY.

---

L O N D O N :

BALDWIN, CRADOCK AND JOY.

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1827.

15

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PRINTED BY RICHARD TAYLOR,  
SHOE-LANE, LONDON.

TO  
THE REV. RICHARD WALOND,  
RECTOR OF WESTON UNDER PENYARD AND  
TREASURER OF THE CATHEDRAL CHURCH  
OF HEREFORD.

DEAR SIR,

*To whom can I with so much propriety dedicate the following sheets as to you, who, in the elegant retirement of private life, have occupied so many of your leisure hours in studying the œconomy and management of Bees, and to whom, by the aid and encouragement you have afforded me, is mainly*

b 2

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*to be attributed the commencement, progress,  
and completion of the work ?*

*I know of no one ; and have therefore to re-  
quest that you will allow me to offer you this  
public testimony of my gratitude and respect ;  
and believe me to be*

*Your faithful and obliged friend,*

*EDWARD BEVAN.*

Woodland Cottage,  
April 5th, 1827.

## ADVERTISEMENT.

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THE work which is now submitted to the judgement of the public, in addition to other faults with which it will no doubt be justly chargeable, may be thought by many to be defective in arrangement; and if the author had aimed to produce a purely scientific work, he would consider such charge as being well founded: but in making a humble attempt to afford a popular view of the present state of apian knowledge, historical, physiological and practical, he conceived that he should most effectually attain his object by mingling the different departments together, particularly where the two former would serve to illustrate or explain the rationale of the latter. Moreover, his first intention was not to offer much more to the public than is contained in Part I. of the work; but the materials grew upon his hands, and consequently after that part was modelled, he was induced by the very great interest which was

excited in his mind by the prosecution of his inquiries, to exceed the limits which bounded his original plan :—the result will be found in Part II. The subject would have admitted of still further extension ; but to have increased the volume beyond its present size would have been to defeat one of the objects of the author, which was so to compress his matter as to place his book within the reach of as many as possible of those to whom he flatters himself it may prove practically useful. Should the public, however, require a second edition, and sufficing reasons urge him to place this series of bee-knowledge under distinct heads, he will endeavour to re-model it, as well as otherwise to improve it, by such alterations as ingenuous criticism may suggest.

## INTRODUCTION.

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ALTHOUGH the great addition which has of late been made to our knowledge of the honey-bee, may seem to render a reference to ancient writers comparatively unimportant; yet a few prefatory observations, upon the rise and progress of apiarian science, may not be out of season.

The natural history and management of bees would probably occupy the attention of man at an early period. Surrounded by a boundless variety of living creatures, he would naturally be led to notice their habits and œconomy; and no part of the animal world, or at any rate no part of the world of insects, would be more likely to engage his consideration than the honey-bee. Honey would, in all probability, constitute one of his earliest luxuries; and as he advanced in civilization, he would, as a matter of course,

avail himself of the industry of its collectors, by bringing them as much as possible within his reach ; and by this means he would take an important step towards an acquaintance with entomology. But the progress made by our earliest progenitors, in this or any other science, is involved in the obscurity and uncertainty necessarily appertaining to the infancy of society.

The first indications of attention to natural history are contained in the Old Testament. The interest which it excited in the mind of SOLOMON, evinces how highly it was esteemed in his time. The records of its first progression are however entirely lost, and no regular history of this science exists prior to the days of ARISTOTLE, who under the auspices and through the munificence of his pupil Alexander the Great, was enabled to prosecute with the greatest advantage, for the time in which he lived, his experiments and inquiries into every department of natural history. Alexander felt so strong a desire to promote this object, that he placed at the disposal of Aristotle a very large sum of money, and in his Asiatic expedition

employed above a thousand persons in collecting and transmitting to him specimens from every part of the animal kingdom. ARISTOTLE is therefore to be regarded as having laid the first foundation of our knowledge of that kingdom. He must likewise have derived great advantages from the discoveries and observations of preceding writers, to whose works he would probably have easy access. No individual naturalist could, without such assistance, have produced so valuable and extensive a work on natural science as that which Aristotle has bequeathed to posterity. And though the opinions of himself and his contemporaries have been transmitted to us in an imperfect manner, and abound in errors, still he and his editor THEOPHRASTUS may be regarded as the only philosophical naturalists of antiquity, whose labours and discoveries present us with any portion of satisfactory knowledge.

The observations of Aristotle on the subject of the honey-bee were afterwards “embellished and invested with a species of divinity, by the matchless pen of VIRGIL,” in his fourth Georgic; and it excites feelings of

regret, that poetry which for its beauty and elegance is so universally admired, should be the vehicle of opinions that are founded in error.

ARISTOMACHUS of Soli in Cilicia had his contemplations for nearly sixty years almost solely occupied by bees; and PHILISCUS the Thracian spent a great portion of his time in the woods, that he might investigate their manners and habits without interruption; whence he acquired the name of *Agrius*. However small their contribution of knowledge may appear to this enlightened age, these ancient worthies must have aided the early progress of their favourite science, and are at all events evidences of the zeal with which it was prosecuted in their day.

About the commencement of the Christian æra, COLUMELLA, who was a very accurate observer and exhibited considerable genius as a naturalist, made some curious and useful remarks upon bees in his Treatise *De Re Rusticâ*: but Columella, like Virgil, appears to have acquiesced in and copied the errors of his predecessors.

After him the elder PLINY gave a sanction

to the opinions which he found prevalent, and added to them others of his own. But Pliny, though a laborious compiler, occupied himself with too great a variety of pursuits to attain excellence in any. As a naturalist, however, he is happy in some of his descriptions. To him we are indebted for the transmission to us of all that was actually known, or supposed to be known, of natural history in his day. I say—supposed to be known, for many of the opinions and conjectures which he has put forth, have been shown by modern investigators to be ill-founded.

The notions of the ancients respecting natural philosophy rested on no rational foundation; ideas of charms and of planetary influence directed their most important pursuits, and led to the formation of very absurd theories. When the writer last named recommends that the dust in which a mule has rolled should be sprinkled on persons who are violently in love, as a sovereign remedy for amatory ardour, and gravely tells us that snakes are sometimes produced from the human medulla,—with much nonsensical stuff of the like kind; we may safely pronounce

that he or his contemporaries or both were very credulous, and that the science of experimental philosophy was scarcely cultivated among them.

After the compilation of Pliny's vast Compendium, nearly fourteen hundred years rolled away without anything being done for entomology or for natural history in general. THE ARABIANS, who alone preserved a glimmer of science during those dark ages that succeeded the fall of the Roman empire, cultivated natural history only as a branch of medicine, and from their writings little can be gleaned in furtherance of our present object.

On the revival of learning in the fifteenth century, and after the discovery of the art of printing, various editions were published of the works on natural history, written by the fathers of that science. SIR EDWARD WOTTON, CONRADE GESNER, and others, produced conjointly a work on insects, the manuscripts of which came into the possession of DR. THOMAS PENRY, an eminent physician and botanist in the reign of Queen Elizabeth. After devoting fifteen years to the improvement of the

work, the Doctor died, and the unfinished manuscripts were purchased at a considerable price by MOUFFET, a contemporary English physician of singular learning, who with great labour and at great expense arranged, enlarged, and completed the work. When nearly ready for the press, he also died; and the papers, after lying buried in dust and obscurity for several years, at last fell into the hands of SIR THEODORE MAYERNE (*Baron d'Aubone*), a court physician in the time of Charles the First, who gave them to the world in 1634. The arrangement of this work is defective; but for the period in which it was written, it is a very complete and respectable Treatise on Entomology. It was highly recommended by Haller; and as a storehouse of ancient entomological lore it has not yet lost its utility. Its pages are embellished with nearly 500 wood-cuts. An English translation of it was published in 1658.

According to Fabius Columna, PRINCE FREDERIC CESI, president of the Roman Academy of Sciences, wrote a treatise upon bees; but the work has not been preserved, and we are unacquainted with its merits.

These authors were succeeded by Goedart, Swammerdam, Maraldi, Ray, Willughby and Lister, who by their indefatigable exertions, towards the close of the 17th century threw very considerable light upon every branch of natural knowledge. GOEDART spent forty years of his life in attending to the proceedings of insects, "daily conversing with insects," as he expresses it, and published in 1662 a work on their natural history; but the plates with which it is embellished form the best part of it. SWAMMERDAM published his celebrated work, "A General History of Insects," in 4to, in 1669: a more enlarged edition in two volumes folio, containing the history of bees, was afterwards published in 1737, under the auspices of Boerhaave, from the manuscript of Swammerdam. Those readers who have patience to wade through these tedious volumes, will find it rewarded by the attainment of much curious information. MARALDI published in the *Memoirs of the Royal Academy of Sciences* for 1712, his account of the manners, genius, and labours of the bee. He is said to have been the inventor of glass hives, and to that invention

may be attributed the success of his inquiries. Swammerdam founded his system upon what has been called the metamorphic basis; and RAY, in conjunction with his friend WILLUGHBY, whom he calls the profoundest of naturalists and the most amiable and virtuous of men, erected his superstructure on the same basis. In the *Historia Insectorum* of Ray, evidently the joint production of himself and WILLUGHBY, especial attention is paid to the Hymenoptera: it contains various interesting observations on their manners and characters; and the descriptions, in which he was assisted by the use of very powerful microscopes, are concise and well drawn. DR. MARTIN LISTER, in an appendix to Ray's work, and in various other writings also, contributed materially to elucidate the science of entomology. MADAME MERIAN likewise deserves well, for her industrious pursuit of this subject, particularly for her beautiful illustration of the metamorphoses of insects in Surinam.

The French natural historian REAUMUR stands prominent among the students of entomology, for the unsurpassed enthusiasm and

accuracy with which he has investigated some of its most intricate parts. To him the genus *Apis* is under greater obligations perhaps than to any entomologist either of ancient or modern times. See his immortal work, "*Memoires pour servir à l'Histoire des Insectes*," in 6 vols. 4to. 1732—1744.

About this period also flourished the great, the illustrious LINNÆUS, whose labours diffused light over every department of natural science, and have justly caused him to be regarded as one of its brightest ornaments. He has generally been considered as the founder of the artificial system of arrangement; but a very near approach to it was made by that brilliant constellation of naturalists whom I have enumerated as having flourished at the close of the 17th century, and who may probably be regarded as having paved the way, and prepared materials, for the formation of his more perfect system.

Afterwards appeared the works of the celebrated BONNET of Geneva, the admiring correspondent of Reaumur, and the patron and friend of Huber. This great physiologist became addicted to the study of entomo-

logy before he was seventeen years of age, from reading *Spectacle de la Nature* ; and his decisive experiments upon Aphides do him the highest credit. His works are universally admired for their candour and ingenuity, as well as for their manifest tendency to promote the happiness of man, by exciting in him the love of knowledge and virtue.

We now come to the physiological discoveries of SCHIRACH, HUNTER and HUBER, men who have wonderfully advanced the science of entomology, by a series of experiments most ably conducted, by the most patient investigation, and the most accurate and enlightened observation, and placed it upon the solid foundation of rational induction.

Several other writers also, both in systematic works and in periodical publications, have contributed to throw much light upon the œconomy and habits of the bee. Of the latter description in our own country may be enumerated ARTHUR DOBBS, Esq. ; THOMAS ANDREW KNIGHT, Esq. ; Sir C. S. MACKENZIE, and the REV. W. DUNBAR.

Hitherto I have referred to the writers on

natural history in general, or to the natural historians of bees in particular : many writers, however, have paid great attention to the domestic management of these insects. Their culture is indeed an object highly deserving the attention of the agriculturist as well as of the natural philosopher. In the hands of a judicious and moderately attentive apiarian, they may become a profitable branch of rural œconomy : even the most humble cottager may be made to participate in the benefit of an improved mode of managing them : and as there is so much to admire in their general œconomy and peculiar habits, the man of leisure may secure to himself a source of pleasing and rational amusement in the possession of an Apiary ; for the pursuit of apiarian science, in common with the study of other branches of natural history, leads to a salutary exercise of the mental faculties, induces a habit of observation and reflection, and may sometimes prove a valuable resource for keeping off that *tædium vitæ*, but too frequently attendant upon a relinquishment of active life. No pleasure is more easily attainable, nor less alloyed by

any debasing mixture ; it tends to enlarge and harmonize the mind, and to elevate it to worthy conceptions of Nature and its Author :

“ . . . . . The men  
Whom Nature’s works can charm, with God himself  
Hold converse ; grow familiar, day by day,  
With his conceptions ; act upon his plan,  
And form to his the relish of their souls.”

AKENSIDE.

In the following Treatise it has been my endeavour to combine, as much as possible, the profitable with the instructive and amusing ; in seeking which object, I have endeavoured to clear the ground before me, of the wild-flowers of conjecture and hypothesis, with which the fecundity of the human imagination has strewed it, and to substitute in their place the less showy but more useful products of experiment and rational deduction, the growth of which it should be the object of every labourer in the field of science to promote. Always bearing in mind that false theories often lead to erroneous practices, I have carefully abstained from an indulgence in theory of a merely speculative kind, and confined myself simply to offering

such opinions to the attention of my readers, as have been confirmed by repeated experiment and observation, and to the recommendation of such practices as have been found useful by myself, or by others on whose reports I can place the fullest reliance.

Among the writers who have improved the domestic management of bees, may be enumerated WARDER, WHITE, THORLEY, WILDMAN, KEYS, BONNER and HUIISH, all of whom have devoted many years of their lives to this important object. Persevering, however, as have been the efforts of the before-named writers to obtain an accurate knowledge of the physiology of bees, and to discover the best plan for their management, there is still much to be learned in both these departments, before the former can be thoroughly understood, or the latter satisfactorily regulated. I do not presume to imagine that I can throw much light upon either of these topics; but, judging from the difficulties which I have myself encountered in collecting the scattered materials of apiarian science, I think that I shall confer a benefit upon future inquirers, if I enable them to possess within a

moderate compass such information as can be relied on. Strongly impressed by the importance of the subject, I have for several years devoted much of my time to its consideration; and independently of the pleasure I have experienced in the prosecution of it, as a most interesting branch of natural history, I have considered that by contributing to extend and improve the culture of the bee, I should assist in converting to useful purposes some portions of those products of the earth which might otherwise be dissipated in the air, washed away by the rain, or chemically changed by the action of various surrounding substances, and in either case be rendered comparatively useless.

Many of the tracts on bees are professedly written for the perusal of the cottager. To him I do not so particularly address myself, as to the more intelligent members of the community; and so far as I am able to succeed in making an impression upon them, I shall consider myself as virtually benefiting the cottager. The latter is generally too much of a machine to be the first to adopt any improvement, however important; he is more

likely therefore to obtain bee-knowledge from the example or *vivâ voce* instruction of his enlightened neighbours, than through the direct medium of the press.

How far I may have succeeded in the object I propose to myself, I must leave to the decision of my readers. It seems to be generally admitted, that a Treatise exhibiting a concise view of the present state of our knowledge of the bee is much wanted; and this result of an attempt to supply that desideratum I now offer to the public, with a hope that it may not be unworthy of its notice.

## CORRIGENDA.

Page. Line.

193, 17, for *lives* read *hives*.

228, 2, after "higher flavour" add "and in its never candying, nor even losing its fluidity by long keeping."

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A GENERAL VIEW  
OF THE  
HISTORY AND PHYSIOLOGY  
OF  
THE BEE.

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PART I.

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CHAPTER I.

HISTORY AND PHYSIOLOGY.

THE BEE is considered by Naturalists as belonging to what are called perfect societies of insects, and, in entomological arrangements, is placed in the order Hymenoptera, genus *Apis*. Of this genus there are many species; Linnæus has enumerated 55; in the *Dictionnaire des Sciences Naturelles* 70 species are characterized; and Mr. Kirby, in his *Monographia Apum Angliæ*, has described above 220, natives of England. The species to which I shall principally call the attention of my readers is the *domestic* HONEY-BEE.

B

Every association of bees comprises three descriptions of individuals ; and each description is distinguished by an appearance and cast of character peculiar to itself.

“ First of the throng and foremost of the whole,

One ‘ stands confest the sovereign and the soul.’ ”

This couplet may, to a limited extent, be applied to other kinds of bees ; but it is more peculiarly applicable to hive-bees, as amongst them there has never been found, in any single family, more than one acknowledged regnant chief, usually designated by the name of Queen ; of whom, as having the highest claim to our attention, I shall first proceed to speak.

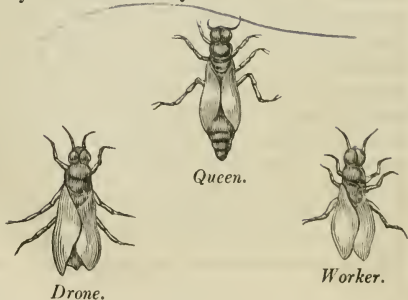
The QUEEN, who is at once the mother and the mistress of the hive, differs, as Mr. Hunter has observed, from the royal chiefs of other insects, such as hornets, wasps and humble-bees ; for the chiefs of these latter societies seem to *work themselves into royalty*, whereas the queen of the hive-bees *reigns from her very birth*. She is distinguishable from the rest of the society by her majestic movements, by the great length of her body, the proportional shortness of her wings, and her bent sting. Her body tapers gradually to a point, her fangs are shorter, her head is rounder, and her trunk not half so long as that of the working bee. Her wings extend only half the length of her body, but are strong and sinewy. Her colours

also distinguish her as much as her shape ; they are much more distinct ; the back is of a much brighter black ; the concentric rings on the under side of her body are darker, and the lighter interstitial part of the same region appears of a brighter and more lively hue. The legs also are of a deep golden yellow colour.

Next in order come the WORKING BEES : these are, by some, called *neuters* or *mules* ; by others, *female non-breeders*. From what will be said hereafter, I think that my readers will consider the latter as the more appropriate title, the workers being sterile females with undeveloped ovaries. In a single hive the number of these varies from 12,000 to 20,000 : they are the smallest members of the community, are furnished with a long flexible proboscis, have a peculiar structure of the legs and thighs, on the latter of which are small hollows or baskets, adapted to the reception of the propolis and farina which they collect, and they are armed with a straight sting. Upon them devolves the whole labour of the colony ; they rear the young, guard the entrances, elaborate the wax, collect and store the provision, and build the cells in which it is warehoused, as well as those that contain the brood.

Thirdly, there are the DRONES OR MALES, to the number of perhaps 1500 or 2000. These make their appearance about the end of April, and are

never to be seen after the middle of August, excepting under very peculiar circumstances which will be stated hereafter. They are one third larger than the workers, somewhat thicker and of a darker colour; they have a shorter proboscis and are more blunt at the tail than either the queen or the workers; the last ring of the body is fringed with hairs, extending over the tail and visible to the naked eye. They make a greater noise in flying and have no sting; are rather shorter than the queen but much larger. Underneath the tail two small protuberances of a yellowish colour may be seen, which are regarded as the distinctive marks of their sex. In some swarms no drones are observable: probably these are first swarms, which, being always led off by old queens, have no occasion for drones, if there be any truth in the theory to be hereafter stated.



Contrary to what occurs in the human species and in other parts of the animal creation, among bees, the females alone exhibit activity, skill, diligence and courage, whilst the males take no part whatever in the labours of the community, but are idle, cowardly and inactive, and possess not the usual offensive weapon of their species. The only way in which the drones promote the welfare of the society is a sexual one ; and I shall endeavour to show, in the course of this chapter, that they serve no other purpose than that of impregnating such of the young queens as may lead forth swarms in the season, or be raised to the sovereignty of the parent hive. As the drones are “never seen settling on any kind of flowers, nor laying up honey in the cells, they most probably feed at home, and fully answer the description given of them by the poet :”

“*Immunisque sedens aliena ad pabula fucus.*” VIRGIL.

“ Their short proboscis sips

No luscious nectar from the wild thyme's lips,  
From the lime's leaf no amber drops they steal,  
Nor bear their grooveless thighs the foodful meal :  
On others toils, in pamper'd leisure thrive  
The lazy fathers of th' industrious hive.”

“ Yet oft, we're told, these seeming idlers share  
The pleasing duties of parental care,  
With fond attention guard each genial cell,  
And watch the embryo bursting from its shell.” EVANS.\*

---

\* The elegant writer from whose unfinished poem, “The Bees,” I have made the above quotations, was for many

Mr. Morris of Isleworth, in the Transactions of the Society for the encouragement of Arts, &c. for 1791, gives it as his opinion that the drones “*sit upon the eggs*, as the mother lays them;” and says that he has “often seen them sit in a formal manner on the combs, when the brood is hatching, while the other bees were very busy at work.” I suspect that Mr. Morris mistook *sleeping* for *brooding*, and that the drones were only taking a nap. Fabricius says that insects never sit on their eggs. Messrs. Kirby and Spence, however, have observed that the female ear-wig does: they also make one other exception in favour of the field bug (*Cimex griseus*), but add that these are the only ones. De Geer has given a very interesting account of both these insects, particularly of the strength of parental affection exhibited by the females. The female of the former assiduously sits upon her eggs, as if to hatch them, and after they are hatched, broods over the young as a hen over young chickens. And when the eggs of the latter are hatched, she also, after the manner of a hen, goes about with the brood, consisting of thirty

years an eminent physician in Shrewsbury, but has now retired into Wales, where I hope he will find sufficient leisure and encouragement to resume the truly classical theme which he has so nearly completed. Of the three parts which have been already published, I shall frequently avail myself in the course of this treatise, as well as of the highly interesting notes which are appended to them.

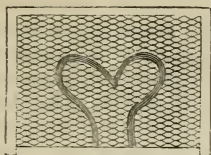
or forty in number and never leaves them: they cluster round her when she is still, and follow her closely wherever she moves.

Besides the three essential members of the bee community, which I have just described, Huber has called the attention of the Apiarian to a fourth kind, which appear to be only casual inmates of the hive, from which however they are soon expelled by the workers. He has called them *black bees*, and says he first noticed them in two of his hives, in the year 1809, and on several other occasions from that time to the year 1813. They present a perfect resemblance to the working bees, excepting in their colour, which, in consequence of their being less downy, appears darker. On dissection, their internal structure also appears to be the same. Huber regards them as imperfect bees, but leaves to future naturalists an inquiry into their nature and origin. Messrs. Kirby and Spence have thrown out a conjecture that these black bees may be *superannuated bees*, that being no longer capable of contributing towards the labours of the community, are banished or destroyed by its younger members. They found their conjecture upon the usual effect of superannuation in rubbing off the hair of insects and thereby giving them a darker hue.

It is the office of the queen bee to lay eggs, which she deposits in cells constructed for their

reception by the working bees. These cells vary from one another in size, (and in the instance of the royal cells, they also vary in form), according as they are intended to be the depositories of eggs that are to become drones, or of those that are to become workers. But for a more particular account of these cells, *Vide* Part II. "Architecture of Bees." The Rev. W. Dunbar, minister of Applegarth, who has recently added some important particulars to our general stock of knowledge respecting bees, states that when the queen is about to lay, she puts her head into a cell, and remains in that position for a second or two, probably to ascertain its fitness for the deposit which she is about to make. She then withdraws her head, and curving her body downwards, inserts her tail into the cell: in a few seconds she turns half round upon herself and withdraws, leaving an egg behind her. When she lays a considerable number, she does it equally on each side of the comb, those on the one side being as exactly opposite to those on the other, as the relative position of the cells will admit. The effect of this is to produce a concentration and œconomy of heat for developing the various changes of the brood. The following sketch is taken from a plate given by Mr. Dunbar in the Edinburgh Philosophical Magazine, to represent the comb upon which his observations were made, and to show that part of

it which was occupied by brood, the surrounding part of the square being full of sealed honey.



The *eggs* of bees are of a lengthened oval shape, with a slight curvature, and of a blueish white colour : they are composed of a thin membrane, filled with a whitish liquor, and being besmeared, at the time of laying, with a glutinous substance, they adhere to the bases of the cells, where they stand upright, and remain unchanged in figure or situation for four days ; they are then hatched, the bottom of each cell presenting to view a small white worm or maggot, with several ventral rings. On its growing, so as to touch the opposite angle of the cell, it coils itself up in the shape of a semi-circle, and floats in a whitish transparent fluid, by which it is probably nourished and enlarged in its dimensions, till the two extremities touch one another and form a ring. In this state it obtains indifferently the name of *worm*, *larva*, *maggot* or *grub*, and is fed with farina or bee-bread, to receive the

welcome morsels of which, it eagerly opens its two lateral pincers. It is the opinion of Reaumur and others that farina does not constitute the sole food of the bee-larvæ, but that it consists of a mixture of farina with a certain proportion of honey and water, partly digested in the stomachs of the *nursing*\* *bees*, the relative proportions of honey and farina varying according to the age of the young. It is insipid whilst they are very young, and becomes sweeter and more acescent the nearer they approach maturity.

Schirach imagined that the semen of the male was the food of the larvæ: Bonnet entertained the same opinion, founded upon his observation that the drones, in going across the combs, pass by those cells that contain no maggots, but stop at those which do, giving a knock with the tail at them three times. Upon this Mr. Hunter observes that *three* is a famous number! and we know very well that the development is complete in hives that do not contain a single drone.

The larva having derived support in the manner above described, for four, five or six days, according to the season†, continues to increase during that period, till it occupies the whole

\* For an account of these see Part II. "Nature and Origin of Bees-wax."

† Schirach asserts, that in cool weather the development takes place two days later than in warm.

breadth and nearly the length of the cell. The nursing bees now seal up the cell, with a light *brown* cover, externally more or less *convex*, (the cap of a drone-cell is more convex than that of a worker,) and thus differing from that of a honey-cell, which is *paler* and somewhat *concave*. It is no sooner perfectly inclosed than it begins to labour, alternately extending and shortening its body, whilst it lines the cell by spinning round itself, after the manner of the silk-worm, a whitish silky film or *cocoon*, by which it is encased, as it were, in a pod or pellicle. "The silken thread employed in forming this covering, proceeds from the middle part of the under lip, and is in fact composed of two threads gummed together as they issue from the two adjoining orifices of the spinner\*." When it has undergone this change, it has usually borne the name of *nymph* or *pupa*.

It may appear somewhat extraordinary that a creature which takes its food so voraciously prior to its assuming the pupa state, should live so long without food, after that assumption: but a little consideration will perhaps abate our wonder; for when the insect has attained the state of pupa, it has arrived at its full growth, and probably the nutriment, taken so greedily, is to serve as a store for developing the perfect insect.

\* Kirby and Spence.

The bee, when in its pupa state, has been denominated, but improperly, *chrysalis* and *aurelia*; for these, as the words import, are of a golden yellow colour and they are crustaceous; whilst the bee-nymphs appear of a pale, dull colour, and readily yield to the touch. The golden splendour, to which the above names owe their origin, is peculiar to a certain species only of the papilio or butterfly tribe. The higher class of entomologists, following the example of Linnæus, apply the term pupa to this state of the embryo bee, a term which signifies that the insect is enveloped in swaddling clothes like an infant, a very apt comparison. Kirby and Spence have remarked that it exhibits no unapt representation of an Egyptian mummy. Huber's translator says that naturalists of the present day incline to use the name of larva, in all cases where the worm is not seen under its final aspect.

The *working bee-nymph* spins its cocoon in thirty-six hours. After passing a certain period in this state of preparation for a new existence, it gradually undergoes so great a change, as not to wear a vestige of its previous form, but becomes armed with a firmer mail, and with scales of a dark brown hue, fringed with light hairs. On its belly six rings become distinguishable, which by slipping one over another, enable the bee to shorten its body whenever it has occasion to do so; its breast

becomes entirely covered with gray feather-like hairs, which as the insect advances in age assume a reddish hue.

When it has reached the twenty-first day of its existence, counting from the moment the egg is laid, it quits the exuviae of the pupa state, comes forth a perfect winged insect, and is termed an *imago*. The cocoon or pellicle is left behind and forms a closely attached and exact lining to the cell in which it was spun: by this means the breeding cells become smaller, and their partitions stronger, the oftener they change their tenants; and when they have become so much diminished in size, by this succession of pellicles or linings, as not to admit of the perfect development of full-sized bees, they are converted into receptacles for honey.

Such are the respective stages of the working bee; those of the royal bee are as follow. She passes three days in the egg and is five a worm; the workers then close her cell\*, and she immediately begins spinning the cocoon, which occupies her twenty-four hours. On the tenth and eleventh days, as if exhausted by her labour, she remains in

\* Instead of being nearly horizontal like the other brood cells, those of the queens are perpendicular and considerably larger; in form they are oblong spheroids, tapering gradually downwards; their mouths being always at the bottom. *Vide* Part II. "Architecture of Bees."

complete repose, and even sixteen hours of the twelfth. Then she passes four days and one third as a nymph. It is on the sixteenth day therefore that the perfect state of queen is attained.

The male passes three days in the egg, six and a half as a worm, and metamorphoses into a fly on the twenty-fourth or twenty-fifth day, after the egg is laid. The great epoch of laying the eggs of males may be accelerated or retarded by the state of the atmosphere promoting or impeding the collections of the bees. The *development* of *each* species likewise proceeds more slowly when the colonies are weak or the air cool, and when the weather is very cold it is entirely suspended. Mr. Hunter has observed that the eggs, maggots and nymphs, all require a heat above 70° of Fahrenheit for their evolution. The influence of temperature in developing embryo insects is very strongly illustrated in the case of the *Papilio Machaon*. According to Messrs. Kirby and Spence, "if the caterpillar of the *Papilio Machaon* becomes a pupa in July, the butterfly will appear in thirteen days; if it do not become a pupa till September, the butterfly will not make its appearance until the following June." And this is the case, say they, with a vast number of other insects. Reaumur proved the influence of temperature, by effecting the regular changes in a hot-house, during the month of January. He also

proved it conversely, by having recourse to an ice-house in summer, which enabled him to retard the development for a whole year.

“The larvæ of bees, though without feet, are not always without motion. They advance from their first station at the bottom of the cell, in a spiral direction: this movement, for the first three days, is so slow as to be scarcely perceptible; but after that it is more easily discerned. The animal now makes two entire revolutions, in about an hour and three quarters; and when the period of its metamorphosis arrives, it is scarcely more than two lines from the mouth of the cell. Its attitude, which is always the same, is a strong curve. This occasions the inhabitant of a horizontal cell to be always perpendicular to the horizon, and that of a vertical one to be parallel with it\*.”

The young bees break their envelope with their teeth, and, assisted at first by the working-bees, proceed to cleanse themselves from the moisture and exuviæ with which they were surrounded: this operation being completed, they begin to exercise their intended functions, and in a few minutes are gathering provision in the fields, loading “in life’s first hour the hollow’d thigh.” M. Maraldi assures us that he has “seen bees loaded with two large balls of wax, returning to the hive,

\* Kirby and Spence.

the same day they became bees." "We have seen her," says Wildman, "the same day issue from the cell, and return from the fields loaded with wax, like the rest." The error of Maraldi and Wildman in using the term wax instead of pollen, does not at all affect the accuracy of their observations. As soon as the young insect has been licked clean and regaled with a little honey by its companions, the latter clean out the cell, preparatory to its being re-occupied by a new tenant or with honey.

With respect to the cocoons spun by the different larvæ, both workers and drones spin *complete cocoons*, or inclose themselves on every side: royal larvæ construct only *imperfect cocoons*, open behind, and enveloping only the head, thorax, and first ring of the abdomen; and Huber concludes, without any hesitation, that the final cause of their forming only incomplete cocoons is that they may thus be exposed to the mortal sting of the first hatched queen, whose instinct leads her instantly to seek the destruction of those who would soon become her rivals. If the royal larvæ spun complete cocoons, the stings of the queens regnant might be so entangled in their silken meshes, as to be with difficulty disengaged from them. "Such," says Huber, "is the *instinctive enmity of young queens to each other*, that I have seen one of them, immediately on its emergence

from the cell, rush to those of its sisters, and tear to pieces even the imperfect larvæ."

A curious circumstance occurs with respect to the hatching of the queen bee. When the pupa or nymph is about to change into the perfect insect, the bees render the cover of the cell thinner, by gnawing away part of the wax; and with so much nicety do they perform this operation that the cover at last becomes pellucid, owing to its extreme thinness, thus facilitating the exit of the fly. After the transformation is complete, the young queens would, in common course, immediately emerge from their cells, as workers and drones do; but the former always keep the royal infants prisoners for some days, supplying them in the mean time with honey for food, a small hole being made in the door of each cell, through which the confined bee extends its proboscis to receive it. The *royal prisoners* continually utter a kind of song, the modulations of which are said to vary. *Vide* Chapter xv. Huber heard a young princess in her cell emit a very distinct sound or clacking, consisting of several monotonous notes in rapid succession, and he supposes the working bees to ascertain, by the loudness of these tones, the ripeness of their queens. Huber has suggested that the cause of this temporary imprisonment may possibly be to enable

the young queens to fly away at the instant they are liberated.

The queen is a good deal harassed by the other bees, on her liberation. This has been attributed to their wishing to impel her to go off with a swarm as soon as possible, but this notion is probably erroneous; it certainly is so if Huber be correct, in saying that the swarms are always accompanied by the older queens. The queen has the power of instantly putting a stop to their worrying, by uttering a peculiar noise, which has been called the *voice of sovereignty*. Bonner however declares that he never could observe in the queen anything like an exercise of sovereignty. But Huber's statement was not founded upon a solitary instance; he heard the sound on various occasions, and witnessed the striking effect which it always produced. On one occasion, a queen having escaped the vigilance of her guards and sprung from the cell, was, on her approach to the royal embryos, pulled, bitten and chased by the other bees. But standing with her thorax against a comb and crossing her wings upon her back, keeping them in motion, but not unfolding them, she emitted a particular sound, when the bees became, as it were, paralysed and remained motionless. Taking advantage of this dread, she rushed to the royal cells; but the sound having ceased as

she prepared to ascend, the guardians of the cells instantly took courage and fairly drove her away. This voice of sovereignty, as it has been called, resembles that which is made by young queens before they are liberated from their cells; it is a very distinct kind of clicking, composed of many notes in the same key, which follow each other rapidly. The sound accompanied by the attitude just described, always produces a paralysing effect upon the bees.

Bees, when deprived of their queen, have the power of selecting one or more grubs of workers, and converting them into queens. To effect this, each of the promoted grubs has a royal cell or cradle formed for it, by having three contiguous common cells thrown into one; two of the three grubs that occupy those cells are sacrificed, and the remaining one is liberally fed with royal jelly. This royal jelly is a pungent food prepared by the working bees, exclusively for the purpose of feeding such of the larvæ as are destined to become candidates for the honours of royalty, whether it be their lot to assume them or not. It is more stimulating than the food of ordinary bees, has not the same mawkish taste, and is evidently acescent. The royal larvæ are supplied with it rather profusely, and there is always some of it left in the cell, after their transformation. Schirach, who was secretary to the Apiarian Society in Upper

Lusatia and vicar of Little Bautzen, may be regarded as the discoverer, or rather as the promulgator of this fact; and his experiments, which were also frequently repeated by other members of the Lusatian Society, have been amply confirmed by those of Huber and Bonner. Mr. Keys was a violent sceptic upon this subject (See his communications to the Bath Society); so likewise was Mr. Hunter (*Vide* Philosophical Transactions). But notwithstanding the criticisms and ridicule of the former, and the sarcastic strictures of the latter, the sex of workers is now established beyond all doubt. The fact is said to have been known long before Schirach wrote: M. Vogel and Signor Monticelli, a Neapolitan professor, have both asserted this; the former states it to have been known upwards of fifty years, the latter a much longer period; he says that the Greeks and Turks in the Ionian Islands are well acquainted with it, and that in the little Sicilian island of Favignana, the art of *producing queens* has been known from very remote antiquity; he even thinks that it was no secret to the Greeks and Romans, though, as Messrs. Kirby and Spence observe, had the practice been common, it would surely have been noticed by Aristotle or Pliny. The result of Schirach's experiments was that all workers were originally females, but that their organs of generation were obliterated, merely because the germs of

them were not developed ; their being fed and treated in a particular manner, in their infancy or worm state, being necessary, in his opinion, to effect that development. Subsequent experiments conducted under the auspices of Huber, have shown, however, that the organs are not entirely obliterated.

Huber has been regarded as a man of a very vivid imagination ; and as his eye-sight was defective, he was obliged to rely very much upon the reports of Francis Burnens, his assistant ; on both which accounts other apiarian writers have thrown some distrust upon his statements. Huish may be reckoned among the number ; he has also made some observations upon Schirach's theory, and treated it with much petulance and ridicule. In answer to him and all other cavillers, I shall detail an experiment made by Mr. Dunbar, in his mirror hive. In July, when the hive had become filled with comb and bees, and well stored with honey ; and when the queen was very fertile, laying a hundred eggs a-day, Mr. D. opened the hive and took her majesty away. The bees laboured for eighteen hours before they appeared to miss her ; but no sooner was the loss discovered than all was agitation and tumult ; and they rushed in crowds to the door, as if swarming. On the following morning he observed that they had founded five queen cells, in the usual way under such cir-

cumstances ; and in the course of the same afternoon, four more were founded, in a part of the comb where there were only eggs a day or two old. On the fourteenth day from the old queen's removal, a young queen emerged and proceeded towards the other royal cells, evidently with a murderous intent. She was immediately pulled away by the workers, with violence, and this conduct on their part was repeated as often as the queen renewed her destructive purpose. At every repulse she appeared sulky, and cried *peep peep*, one of the unhatched queens responding, but in a somewhat hoarser tone. (This circumstance affords an explanation of the two different sounds which are heard, prior to the issuing of second swarms.) On the afternoon of the same day, a second queen was hatched ; she immediately buried herself in a cluster of bees. Next morning Mr. D. observed a hot pursuit of the younger queen by the elder, but being called away, on his return half an hour afterwards, the former was dying on the floor, no doubt the victim of the other. Huber has stated that these artificial queens are mute ; but the circumstance noticed by Mr. Dunbar of the two queens, just referred to, having answered each other, disproves that statement. Contrary also to the experience of Huber, Mr. D. found that the cells of artificial queens were surrounded by a guard. I have just adverted to the protection

which they afforded to the royal cells, when assailed by the first hatched queen.

That *the working bees are females* is clear from the circumstance of their being known occasionally to lay eggs. This fact was first noticed by Riem, and was afterwards confirmed by the experiments of Huber, whose assistant, on one occasion seized a fertile worker in the very act of laying. It is a remarkable fact that these *fertile workers* never lay any but *drones'* eggs. This uninterrupted laying of *drones'* eggs was noticed by the Lusatian observers, as well as by the naturalist of the Palatinate. Bonnet, on referring to this fact, supposes there must have been small queens mixed with the workers upon which the experiments were made, whose office it was to lay male eggs in *all* hives; for neither he nor the before-named observers imagined that the workers were ever fertile, though from the oft repeated experiments, just alluded to, they must have regarded them as females. Probably the fertility of these workers is occasioned by some royal jelly being casually dropped into their cells, when grubs, as they uniformly issue from cells adjoining those inhabited by grubs, that have been raised from the plebeian to the royal rank; of course therefore they are never found in any hives but those which have had the misfortune to lose their queen. Fertile workers appear smaller in the belly and more slender in the body

than sterile workers, and this is the only external difference between them.

If any further proof were required to establish the opinion that working bees are females, the question has been set at rest for ever, by *the dissections of Miss Jurine*, daughter of the distinguished naturalist of Geneva : what had eluded the scalpel and the microscope of that penetrating and indefatigable naturalist Swammerdam, was reserved for the still finer hand and more dexterous dissection of a lady. Miss Jurine, by adopting a particular method of preparing the object to be examined, brought into view the rudiments of the ovaria of the common working bee : her examinations were several times repeated, and always with success : in form, situation and structure, they were found to be perfectly analogous to those of the queen bee, excepting that no ova could be distinguished in them. M. Cuvier, however, thinks that he has observed minute chaplets in common bees, resembling those in the oviducts of queens ; an additional confirmation, if any were wanted, of the opinion that workers are females whose organization is not developed. Miss Jurine undertook the delicate task to which I have just referred, at the request of M. Huber, who speaks of her as a young lady who had devoted her time and the liberal gifts of nature to similar studies, and says that she already rivalled Lyonnet and Merian ; but

adds, "we had soon to deplore her loss." The research was first made to ascertain whether black bees, which, when they appear in a hive, are much persecuted, were exposed to this persecution in consequence of their sex exciting the jealousy of the queen. The success of the investigation induced this accomplished young lady to extend her dissection to the common workers, which was crowned with a result equally gratifying. Parallel instances have been observed with regard to the humble-bee, the wasp and the ant, amongst which, those that have usually been called neuters are found to be females, and when fertile, they, like the fertile workers in a bee-hive, produce males universally.

Having now traced these insects through their regular stages of egg, larva, nymph, until they become perfect bees, and having noticed the facts which show the working bees to be females, I shall advert to the more intricate and mysterious business of *Impregnation*. This is a subject which was long involved in obscurity, and which indeed is still clouded by some uncertainty. Schirach and Bonner stoutly denied the necessity of sexual intercourse between the queen and the drones, considering the former as a mother and yet a virgin, and Swammerdam was of the same opinion; he ascribes impregnation to a vivifying seminal aura, which is exhaled from the drones and pene-

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trates the body of the queen. This opinion arose from his observing a very strong odour to be exhaled, at certain times, from the drones; "*Hanc sententiam ratam habuit, quia organa apum propagini servientia, sexus utriusque, ritè dissecta, inter se ita disparia videbantur, ut congressus ne fieri quidem ullo pacto posset.*" His opinion with respect to the vivifying influence of the seminal aura also accounted satisfactorily, to his own mind, for there being such a prodigious number of drones, as, in proportion to their number, would of course be the intensity of their peculiar odour. Reaumur very successfully combated this fanciful doctrine, and Huber has confuted it by direct experiment. Reaumur inclined to the opinion that there was a sexual intercourse, though his experiments left that question undecided. Arthur Dobbs, esq. has given it as his opinion that the queen's eggs were impregnated by coition with the drones, and that a renewal of the intercourse was unnecessary. He however thought that she had intercourse with several, instead of with one only, in order that there might be a sufficient deposition of sperm to impregnate all her eggs. About the beginning of the last century, Maraldi broached another hypothesis; he imagined that the eggs were fecundated by the drones, after the queen had deposited them in the cells, similarly to what takes place in the fecun-

dation of fish-spawn. In 1777 that ingenious naturalist Mr. Debrow, who was apothecary to Addenbroke's Hospital at Cambridge, also adopted this opinion ; and even so late as the year 1817 Huish has supported the same doctrine, and I believe does so at the present time. Debrow thought he had discovered the prolific fluid of the drones, in the brood cells, which fertilizing the eggs caused them to produce larvæ. Huber repeated the experiments of Debrow, and at first gave him credit for the reality of the discovery ; but further and more minute observation convinced him that it was illusory, and that what he, as well as Debrow had taken for seminal fluid, was nothing more than light reflected from the bottoms of the cells, when illuminated by the sun's rays. Moreover, it did not escape the acute mind of Huber, that eggs were laid and larvæ hatched, when there were no drones in existence, viz. between the months of September and April. The two hypotheses just mentioned, accounted satisfactorily, to their supporters, for the prodigious disproportion in the number of the sexes. But Huber made the experiment of confining the queen and rigidly excluding every male from a hive ; nay more, he carefully examined every comb, and satisfied himself that there was neither male nymph nor worm present ; and lest it should be supposed that the fertilizing fluid might be imported from other

hives, he totally confined the bees, on two occasions, and still the eggs were prolific; which proves clearly that their fertility must have depended upon the previous impregnation of the queen. The analogy of wasps is indeed admitted, by Huish, to discountenance the opinion which he entertains in common with Maraldi and Debraw. The queen wasp alone, survives the winter, and deposits her first eggs in the ensuing spring in combs of her own construction. Here then impregnation must have taken place in the preceding autumn, whilst the eggs were in the ovaria. It was the opinion of Hattorf, Schirach, and probably also of Bonner, that the queen-bee impregnated herself; but this opinion is too extravagant to require serious refutation: it arose probably, from their making experiments upon queens taken indiscriminately from the hives, and which had previously been impregnated. This no doubt misled Debraw, who, without knowing it, had chosen for experiment some queens that had had commerce with the males. The experiments of Huber were made upon virgin-queens, with whose history he was acquainted from the moment of their leaving their cells. In the course of his experiments he found that the queens were never impregnated, so long as they remained in the interior of the hive; but that *impregnation always takes place in the open air*, at a time when the

heat has induced the drones to issue from the hive ; on which occasions, the queen soars high in the air, love being the motive for the only distant journey she ever takes. "The rencontre and copulation of the queen with the drone take place exterior to the hive," says Lombard, "and whilst they are on the wing." They are similarly constituted with the whole family of flies. A corresponding circumstance may also be noted with respect to the queen-ant ; and Bonnet, in his *Contemplations de la Nature*, has observed that *she* is always impregnated whilst she is on the wing. The dragon-flies copulate as they fly through the air, in which state they have the appearance of a double animal.

..... "When noon-tide Sirius glares on high,  
 ..... Young Love ascends the glowing sky,  
 From vein to vein swift shoots prolific fire,  
 And thrills each insect fibre with desire.  
 Thence, Nature, to fulfil thy prime decree,  
 Wheels round, in wanton rings, the courtier bee ;  
 Now shyly distant, now with bolden'd air,  
 He woos and wins the all-complying fair :  
 Through fields of ether, veil'd in vap'ry gloom,  
 They seek, with amorous haste, the nuptial room ;  
 As erst th' immortal pair, on Ida's height,  
 Wreath'd round their noon of joy, ambrosial night."

EVANS.

The males and the fertile females, among ants, are winged insects ; the former, as in the case of drone bees, perish a short time after their amours ;

and the females, having alighted upon a spot suitable for the formation of a colony, cut off their own wings, as being no longer of any use to them. (Linnaeus had observed that the females lost their wings a certain period after impregnation.) A domino Hunter didici, se bombinatrices sub oculos in coitu junctos, ut apud muscas mos est, vidisse. "Aculeus," inquit, "articulo temporis ejicitur, et inter gemina insecta, dorso feminae imponitur. Hoc situ aliquandiù manent." In the hornet it is the same.

If the queen-bee be confined, though amid a seraglio of males, she continues barren. Prior to her flight, (which is preceded by the flight of the drones,) she reconnoitres the exterior of the hive, apparently for the purpose of recognition, and sometimes, after flying a few feet from it, returns to it again: finally she rises aloft in the air, describing in her flight horizontal circles of considerable diameter, till she is out of sight. She returns from her aërial excursion in about half an hour, with the most evident marks of fecundation. Excursions are sometimes made for a shorter period, but then she exhibits no sign of having been impregnated. It is curious that Bonner should have remarked those aërial excursions, without suspecting their object. "I have often," says he, "seen the young queens taking an airing upon the second or third day of their age." Yet Huish says,

“ It is an acknowledged fact that the queen-bee never leaves the hive, on any account whatsoever.” Perhaps Huish’s observations were made upon first swarms ; and these, according to Huber, are uniformly conducted by old queens. Swammerdam also made the same observation as to *first swarms being always led off by old queens*. Old queens have not the same occasion to quit the hives that young ones have,—viz. to have intercourse with the drones ; for, according to Huber, one impregnation is sufficient to fertilize all the eggs that are laid for two years afterwards, at least. He *thinks* it is sufficient to fertilize all that she lays during her whole life. This may appear, to some, an incredible period ; and Huish inquires, admitting that a single act of coition be sufficient to fecundate all the eggs existing in the ovaria at the time, how those are fecundated which did not exist there ? But when we consider that in the common spider, according to Audebert, the fertilizing effect continues for *many years* ; and that the fecundation of the eggs of the female aphides or green lice, by the males of one generation, will continue for a year, passing, during that period, through *nine or ten successive generations* of females, the causes for doubt will, I think, be greatly diminished : at any rate we are not at liberty to reject the evidence of facts, because we cannot understand their *modus operandi*. With respect

to the aphis, Bonnet says the influence of the male continues through *five* generations, but Lyonnet carried his experiments to a more extended period ; and according to Messrs. Kirby and Spence, who give it “ upon the authority of Mr. Wollough of Hollesley (late of Boyton) in Suffolk, an intelligent agriculturist, and a most acute and accurate observer of nature, there may be *twenty* generations in a year.” Reaumur has proved that in *five* generations one aphis may be the progenitor of 5,904,900,000 descendants. It may be objected to me here, that the aphis is a viviparous insect, and that the experiments which prove what I have referred to, do not therefore bear upon the question. It has been ascertained, however, that they are strictly oviparous at the close of the year (one species is at all times so), at other times ovo-viviparous ; and in either case the penetrating influence of the male sperm is surely still more remarkable where there has been no immediate commerce with the male, than in the direct case of the oviparous bee ! It has been observed, however, that the further the female aphides are removed from the first mother, or that which had known the male, the less prolific do they become. In order to put my readers in possession of Dr. Fleming’s opinion upon this subject, I will quote what he has said in his *Philosophy of Zoology*. “ Impregnation, in insects, appears to take place

while the eggs pass a reservoir containing the sperm, situated near the termination of the oviduct in the vulva. In dissecting the female parts, in the silk-moth, says Mr. Hunter, I discovered a bag, lying on what may be called the vagina or common oviduct, whose mouth or opening was external, but it had a canal of communication betwixt it and the common oviduct. In dissecting these parts, before copulation, I found this bag empty; and when I dissected them afterwards, I found it full. (Phil. Trans. 1792. p. 186.) By the most decisive experiments, such as covering the ova of the unimpregnated moth, after exclusion, with the liquor taken from this bag, in those which had had sexual intercourse, and rendering them fertile, he demonstrated that this bag was a reservoir for the spermatic fluid, to impregnate the eggs, as they were ready for exclusion, and that coition and impregnation were not simultaneous." Linnæus thought that there was a sexual intercourse between the queens and the drones, and he even suspected that it proved fatal to the latter. His opinion, on both these points, seems to be confirmed by the experiments of Huber; who ascertained by repeated observations on newly impregnated queens, "*Fuci organum, post congressum, in corpore feminæ hæsisse, unde exitus fatalis expectandus est; ita autem accidere reverâ non liquet.*" "*Apum regina et mater,*" says Mr.

Kirby, "in sublime fertur maritum infelicem petens, qui voluptatem brevem vitâ emat." Reaumur thought sexual union necessary to impregnation, and tried many experiments to ascertain the fact; such as confining a queen under a glass in company with drones: and these experiments were repeated by Huber. Both these naturalists witnessed the solicitations and advances of the queens towards the drones, "*nihilominùs, coeuntia tempore quovis conspiciere non possent.*" Reaumur *fancied* he saw it; there is, however, very great reason to believe that he was mistaken: the queens so exposed all proved barren. Swammerdam asserted that clipping the wings of queens rendered them sterile, a fact which militates very much against his own theory of impregnation being produced by a seminal aura, but strongly confirms the theory of Huber; as in all probability the mutilating experiments of Swammerdam were made upon virgin queens, which thereby lost the power of quitting the hives. Huber found that clipping the wings of *impregnated* queens produced no effect upon them; it neither diminished the respectful attentions of the workers, nor interfered with their laying of eggs. Why impregnation can only take place in the open air and when the insects are on the wing, at present remains a mystery.

The young virgin queens, generally, set out in quest of the males, the day after they are settled

in their new abode, which is usually the fifth day of their existence as queens, two or three days being passed in captivity, one in the native hive after their liberation, and the fifth in the new dwelling. The ancients seem to have been very solicitous to establish for the bees a character of inviolable chastity: Pliny observes, "*Apium enim coitus visus nunquam.*" And Virgil endeavours to support the same opinion:

" But of all customs which the bees can boast,  
'Tis this that claims our admiration most;  
That none will Hymen's softer joys approve,  
Nor waste their spirits in luxurious love:  
But all a long virginity maintain,  
And bring forth young without a mother's pain."

It was the opinion of most ancient philosophers that bees derived their origin from the putrid carcases of animals. *Vide* Chap. II. Some also have supposed them to proceed from the parts of fructification in flowers. Virgil, borrowing as usual from Aristotle, among the rest:

" Well might the Bard, on fancy's frolic wing,  
Bid, from fresh flowers, enascent myriads spring,  
Raise genial ferment in the slaughter'd steer,  
And people thence his insect-teeming year;  
A fabled race, whom no soft passions move,  
The smile of duty nor the glance of love." EVANS.

" To vindicate, in some measure, the character of the insect queen, Mr. Wildman boldly dared

to stem the torrent, and revive the long forgotten idea suggested by Mr. Butler in his *Feminine Monarchy*, that queens produce queens only, and that the common bees are the mothers of common bees." But all these fanciful notions must yield to the clear and decisive experiments of Huber, who has satisfactorily shown that *the queen is the general mother of all*; he has also resolved the causes of former mistaken opinions. Many apiarists have found a difficulty in admitting the theory of Huber, in consequence of the very great disproportion in the number of the sexes, there being only one female to several hundred males, and one impregnation being, in his opinion, all that is required to fertilize myriads of eggs. The number of drones may be considered as in accordance, in some degree, with the general profusion of nature: we find her abounding with supernumeraries in a great variety of instances, in the blossoms of trees and flowers, as well as in the relative number of one sex to the other among animals. Huber conceives that it was necessary there should be a great number of drones, that the queen might be sure of finding one, in her excursion through the expanse of the atmosphere, and run no risk of sterility.

In page 26 I have stated the opinion of Mr. Dobbs, that a queen has intercourse with several drones; and what I have also stated upon the au-

thority of Mr. Hunter, in page 34, with respect to the silk-moth and other insects, gives countenance to that opinion: nor do I see its inconsistency with the discovery made by Huber. Though there is reason to believe that the act proves fatal to one devoted drone, yet those that are so fortunate as to obtain the first favours of her majesty, may escape uninjured. If the conjecture which I have thus hazarded be correct, it will appear less surprising that so many drones should be brought into existence.

The queen begins to lay her eggs as soon as a few portions of comb are completely formed. By the time that combs five or six inches square are constructed, eggs, honey and bee-bread will be found in them. Huber states that *the laying usually commences forty-six hours after the intercourse with the male; and that during the eleven succeeding months, the eggs of workers only are laid; after which a considerable and uninterrupted laying of drones' eggs commences*. This period may be retarded by the temperature of the atmosphere. Huber relates an instance where, the weather having become suddenly cold, after an impregnation which took place on the 31st of October, that queen did not lay till the March following. The effects of retardation will be noticed presently. *Twenty days after the queen has begun to lay the eggs of drones, "the working bees,"* says Huber,

*“construct the ROYAL CELLS, in which the queens, without discontinuing the laying of male eggs, deposit, at the interval of one, two or three days, those eggs from which the queens are successively to spring.”* This laying of the eggs of drones, which is called the great laying, usually happens in May. There seems to be a secret relation between the production of these eggs, and the construction of royal cells: the laying commonly lasts thirty days, and regularly on the 20th or 21st day, as has been already observed, royal cells are founded. *When the larvæ, hatched from the eggs laid by the queen in the royal cells, are ready to be transformed to nymphs, this queen leaves the hive, conducting a swarm along with her.* A swarm is always led off by a single queen; and Huber remarks that it was necessary for instinct to impel the old queen to lead forth the first swarm; for, being the strongest, she would never fail to overthrow the younger competitors for the throne, near which “the jealous Semiramis of the hive will bear no rival.” The queen, having finished her laying of male eggs and of royal eggs, prior to her quitting the old hive, is ready to commence, in the new one, with the laying of workers’ eggs, workers being first needed, in order to secure the continuance and prosperity of the newly founded commonwealth. The bees that remain in the old hive take particular care of the royal cells, and prevent

the young queens, successively hatched, from leaving them, except at an interval of several days from each departure. But I have already adverted to their mode of proceeding on these occasions. *Vide* page 17. *The law of primogeniture* is always strictly observed towards these royal insects, the first-born or princess-royal being always selected to go off with the second swarm, or to reign over the parent stock, as the case may be; and so on with respect to the third and fourth, or whatever number may issue. It is remarkable that a queen seldom, if ever, leads forth a swarm, except there be sunshine and calm air. Such a ferment occasionally rages in the hives, as soon as the young queens are hatched, that Huber has often observed the thermometer placed in the hive, rise suddenly from about  $92^{\circ}$  to above  $104^{\circ}$  Fahrenheit. This suffocating heat he considers as one of the means employed by nature for urging the bees to go off in swarms. *In warm weather one strong hive has been known to send off four swarms in 18 days.* *Vide* Chap. XIII.

According to Huber, *the queen ordinarily lays about 12,000 eggs in two months*, one impregnation serving, as has been before stated, for the whole complement of eggs, of every description, which she lays during two years at least. It is not to be supposed that she lays at the rate of 12,000 eggs every two months, but she does so at the

principal laying in April and May: there is also another great laying in August. Early in November the laying usually ceases. Reaumur states the number of eggs laid by a queen in two months at double the amount of Huber's calculation; viz. 200 a day, on an average. This variation may have arisen from variety of climate, season, or other circumstances. *A moderate swarm has been calculated to consist of from 12,000 to 20,000, which is about a two months' laying.* Schirach says that *a single queen will lay from 70,000 to 100,000 eggs in a season.* This sounds like a great number; but it is greatly exceeded by some other insects. The female of the white ant extrudes not less than 60 eggs in a minute, which gives 3600 in an hour, 86,400 in a day, 2,419,200 in a lunar month, and the enormous number of 211,449,600 in a year. Though she does not lay all the year probably, yet, setting the period as low as possible, her eggs will exceed the number produced by any other known animal in creation.

If the *impregnation* of a queen be by any means *retarded* beyond the 20th or 21st day of her life, a very extraordinary consequence ensues. Instead of first laying the eggs of workers, and those of drones, at the usual period afterwards, she begins from the 45th hour to lay the latter, and lays no other kind during her whole life. It should seem

as if the rudiments of the workers' eggs withered in the oviducts, but without obstructing the passage of the drones' eggs. The only known fact analogous to this is the state of certain vegetable seeds, which lose the faculty of germination from age, whatever care may have been taken to preserve them. This retardation seems to have a singular effect upon the whole animal œconomy of the queen. "The bodies of those queens," says Huber, "whose impregnation has been retarded, are shorter than common; the extremities remain slender, whilst the first two rings, next the thorax, are uncommonly swollen." In consequence of the shortening of their bodies, their eggs are frequently laid on the sides of the cells, owing probably to their not being able to reach the bottom; the difficulty is also increased by the two swollen rings. In these cases of retarded impregnation and exclusive laying of drones' eggs, the prosperity of the hive soon terminates; generally before the end of the queen's laying. The workers receiving no addition to their number, but on the contrary, finding themselves overwhelmed with drones, sacrifice their queen and abandon the hive. These retarded queens seem to have their instincts impaired; for they deposit their eggs indiscriminately in the cells, whether originally intended for drones or for workers,—a circumstance which ma-

terially affects the size of the drones that are reared in them. There are not wanting instances of royal cells being occupied by them, and of the workers being thereby so completely deceived as to pay the tenants, in all respects, the honours of royalty. This circumstance appears the more extraordinary, since it has been ascertained that when eggs have been thus inappropriately deposited, by fertile workers, they are uniformly destroyed a few days afterwards, though for a short time they receive due attention.

The workers have been supposed by some apirians to transport the eggs from place to place ;—if ever such were the case, this would seem to be an occasion calling for the practice : on the contrary, instead of removing the eggs from the sides to the bottoms of the cells, for the sake of better accommodation, this object is accomplished by their lengthening the cells, and advancing them two lines beyond the surface of the combs. This proceeding affords pretty good evidence that *the transportation of eggs* forms no part of the workers' occupation. It is still further proved by their eating any workers' eggs, that a queen may, at any time, be forced to deposit in drones' cells, or drop at random in other parts of the hive ; a circumstance which escaped the notice of former naturalists, and misled them in their opinion respect-

ing transportation. A somewhat similar circumstance was noticed by Mr. Dunbar in his mirror hive. (For an account of this hive see Chap. X.) Mr. Dunbar observed that whenever the queen dropped her eggs carelessly, they were eagerly devoured by the workers. Now if transportation formed a part of their employment, they would in these cases, instead of eating the eggs, have deposited them in their appropriate cells. It seems very evident therefore that the proper disposition of the eggs is left entirely to the instinct of the queens. The workers having been seen to run away with the eggs, in order to devour them, in all probability gave birth to the mistaken notion that they were removing them to their right cells. Among humble-bees, there is a disposition, among the workers, to eat the eggs, which extends even to those that are laid in proper cells, where the queens often have to contend for their preservation.

After the season of swarming, viz. towards the end of July, as is well known, a general *massacre of the drones* takes place. The business of fecundation being now completed, they are regarded as useless consumers of the fruits of others labour, "*fruges consumere nati*;" love is at once converted into furious hate, and a general proscription takes place. The unfortunate victims evidently

perceive their danger ; for they are never, at this time, seen resting in one place, but darting in or out of the hive, with the utmost precipitation, as if in fear of being seized. Their destruction has been generally supposed to be effected by the workers harassing them till they quit the hive : this was the opinion of Mr. Hunter, who says the workers pinch them to and fro, without stinging them, and he considers their death as a natural rather than an untimely one. In this Bonnet seems to agree with Mr. Hunter. But Huber has observed that *their destruction is effected by the stings of the workers* : he ascertained this by placing his hives upon a glass table, as will be stated under the anatomy of the bee, article "Sting." Reaumur seems to have been aware of this, for he has remarked that "notwithstanding the superiority which the drones seem to have from their bulk, they cannot hold out against the workers, who are armed with a poniard which conveys poison into the wounds it makes." The moment this formidable weapon has entered their bodies, they expand their wings and expire. This sacrifice is not the consequence of a blind indiscriminating instinct, for *if a hive be deprived of its queen, no massacre takes place*, though the hottest persecution rage in all the surrounding hives. This fact was observed by Bonner, who supposed the drones to be

preserved for the sake of the additional heat which they would generate in the hive during winter; but according to Huber's theory, they are preserved for the purpose of impregnating a new queen. The lives of the drones are also spared in hives which possess fertile workers only, but no proper queen, and likewise in hives governed by a queen whose impregnation has been retarded; but under any other circumstances the drones all disappear before winter. Not only all that have undergone their full transformations, but every embryo, in whatever period of its existence, shares the same fate. The workers drag them forth from the cells, and after sucking the fluid from their bodies, cast them out of the hive. In all these respects the hive-bees resemble wasps, but with this difference; among the latter, not only are the males and the male larvæ destroyed, but all the workers and their larvæ, (and the very combs themselves,) are involved in one indiscriminate ruin, none remaining alive during the winter but the queens, which lie dormant in various holes and corners till the ensuing spring,—of course without food, for they store none. The importance of destroying these mother wasps in the spring will be noticed in another place.

Morier in his second journey through Persia (page 100) has recorded a fact, which, though it

did not come under his own immediate observation, was related to him by a person on whose authority he could place full reliance, and which is directly the reverse of what I have stated respecting bees. It is, that among the locusts, when the female has done laying, she is surrounded and killed by the males.

## CHAPTER II.

## THE APIARY.

THE first object of consideration, in the establishment of an apiary, is situation.

The aspect has, in general, been regarded as of prime importance, but I think there are other points of still greater importance.

An apiary would not be well situated near a great river, nor in the neighbourhood of the sea, as windy weather might whirl the bees into the water and destroy them.

It was the opinion of the ancients that bees, in windy weather, carried weights, to prevent them from being whiffled about, in their progress through the air: Virgil has observed that

“ They with light pebbles, like a balanc’d boat,  
Pois’d, through the air on even pinions float.”

SOTHEY’S GEORGICS.

This assertion, which was probably borrowed by the poet from his predecessor Aristotle, and which has since been repeated by Pliny, is now ascertained to be erroneous. The error has been noticed by both Swammerdam and Reaumur, and ascribed by them to preceding observers having mistaken the mason bee for a hive bee. The former builds its nest against a wall, with a composi-

tion of gravel, sand and its own saliva, and when freighted with the former article, may easily have led a careless observer into the erroneous opinion above alluded to.

From a similar inaccuracy of observation, it is probable that flies were confounded with bees by ancient naturalists, and that from thence arose the absurd notion, of the latter being generated in putrid carcases, as we know the former to be ; and this error was most likely confirmed by their having found both honey and bees in the carcases of dead animals, as recorded in the case of Samson.

Though, for the reasons above stated, an apiary would not be well situated near a large river, yet it should not be far from a rivulet or spring : small ones, that glide gently over pebbles, are the most desirable, as affording a variety of resting places for the bees to alight upon. If neither spring nor streamlet be near, a broad dish of water should be placed for the bees, the bottom being covered with small stones or duckweed, to facilitate their drinking and prevent drowning.

This, in a hot dry season, is of considerable importance, as it will save that time, which must otherwise be spent, in fetching water from a distance ; for without water, as will be noticed hereafter, no wax can be formed.

It is of course of the greatest importance that

the apiary be situated near to good pasturage, such as clover, saintfoin, buckwheat, &c.—better still if in a garden well stocked with suitable plants.

It should be near the residence of the proprietor, as well for the purpose of rendering the bees tractable and well acquainted with the family, as for affording a good view of their general proceedings; if it be so situated that its front may form a right angle with the window of the family sitting-room, an easy opportunity will be afforded to watch the bustle of swarming.

An out-door apiary should admit of being approached at the back part, to give an opportunity of making observations on the proceedings of the bees, or to perform any requisite operation upon them.

The hives should be placed upon separate stands, supported by single posts or pedestals, be raised from sixteen inches to two feet above the ground, and be three or four feet from each other; and they should stand quite clear of any wall or fence.

The resting boards should project several inches in front of the hives, that the bees may have plenty of room to alight, when they return home loaded from the fields, and should be screwed down firmly to the tops of the stands, that the

hives may not be overturned by high winds or other accidents.

They should be free from the droppings of trees, from noisome smells and disagreeable noises ; and be guarded as much as possible from the extremes of heat and cold.

Most apiarians are agreed that the aspect of the apiary should, in this country, be more or less southerly, and that it should be well secured from the north and south-west, by trees, high hedges, or other fences ; this is the opinion of Wildman, Keys, and Huish ; Bonner, however, prefers an easterly aspect ; Huish recommends two points to the east and one to the south. Wildman preferred a south-west aspect, as not tempting the labourers to emerge too early, and as affording a later light for their return home in the evening.

“ Skreen’d from the east ; where no delusive dawn  
Chills, while it tempts them o’er the dew damp lawn,  
But, as on loaded wing, the labourers roam,  
Sol’s last bright glories light them to their home.”

EVANS.

Milton says : “ It is not material in what aspect the stock stands, provided the sun shines on the hive once in the course of the day, for that well-peopled hives, kept dry, will thrive in most situations.” And provided due attention be paid to

other circumstances calculated to promote their prosperity, I coincide in opinion with Milton.

Some recommend a valley or hollow glen, for the convenience of the bees returning home with their loads. At any rate care should be taken that no walls, trees, houses, nor any thing else, impede the issuing forth of the bees to their pasturage, nor obstruct their return in right lines to the hives. They should be able to fly off from the resting boards at an angle of about forty degrees with the plane of the horizon.

To those who, residing in towns, may consider it as indispensable to the success of an apiary, that it should be in the *immediate* vicinity of good pasturage, and be thereby deterred from benefiting and amusing themselves by keeping bees; it may be satisfactory to learn, that the apiary of the celebrated Bonner was situated in a garret, in the centre of Glasgow, where it flourished for several years, and furnished him with the means of making many interesting and valuable observations, which he gave to the world about thirty years ago.

## CHAPTER III.

~~THE BEE-HOUSE.~~

No one that could afford to purchase bee-boxes, and to construct a bee-house, or to convert to that use some building already constructed, would hesitate, I should think, to give them the preference over common straw hives and an outdoor apiary, whether he looked to ultimate profit or to present convenience and security.

Perhaps I cannot give a better notion of what I consider as the most eligible plan of a bee-house, than by describing the construction of my own. The whole building, besides answering the purpose of an apiary, may be made subservient to other uses;—my own serves for storing potatoes. The potatoe-cellar is sunk two thirds of its depth in the earth, and the bee-house is raised upon it, having a couple of steps up to the door. The dimensions of both are seven feet six inches by six feet clear within, which affords room for five colonies.

The piles or stories of bee-boxes are placed in the bee-house at somewhat less than two feet apart, so as to make the external entrance to each pile respectively, about a yard asunder.—See the plate which forms the frontispiece of this work.

On the inside of the bee-house, the boxes in the upper row stand about table height, those in the lower row, about six inches above the floor. On the outside, the entrances to the upper row are about five feet, the entrances to the lower row about three feet from the ground. The entrances through the wall may be cut in stone, bricks or wood, and should be chamfered away on the outside, leaving the wall at those parts as thin as practicable, and letting the opening correspond in size with the outlets that are sunk in the floor boards to be hereafter described. The potatoe-cellar is built with bricks, the bee-house of timber, lathed and plastered within, and thatched on the outside.

Where the bees enter the boxes, two wooden shelves or resting boards are fixed, two or three inches thick, to prevent warping; they extend the whole length of the building, are about a foot wide, and rest on cross pieces, nailed fast to the uprights with which the bee-house is built: these cross pieces extend also about fifteen inches into the bee-house, where they serve as supporters for the shelves on which the bee-boxes are placed. The resting boards on the outside are divided, by bricks on the edge, into several compartments, as shown in the frontispiece; the bricks extend the full width of the resting board, and all the compartments are slated over. By this means the

entrances are well sheltered, and accommodation is afforded for the bees, when they are at any time driven home, by stress of weather, in greater numbers than can readily pass through the entrances into the boxes; for on the approach of a storm, the bees will sometimes return home from the fields, in such numbers and with such precipitation, as almost to block up the entrances into the hives.

The building is not only thatched on the top, but down the sides and ends, as low as the potatoe-cellar. On that side where the bees enter the boxes, the thatch of course terminates at the top of the compartments, over which it is spread out so as to conceal the slate coverings. The floor of the bee-house is boarded and the potatoe-cellar is ceiled, the space between the ceiling and the floor above being filled with dry sawdust. The door may be situated where most convenient; but the window or windows should be at one end or at both ends, that the light may fall sideways on the bee-boxes, and should be made to open, as in case of any of the bees accidentally getting into the bee-house, they may be let out more conveniently.

It is necessary to have an extra entrance, or rather an extra outlet, for discharging the bees when the time of deprivation arrives, which will be hereafter explained. My own outlet is placed in a line with and between the lower tier of boxes.

## CHAPTER IV.

~~PASTURAGE.~~

It is of the first importance to the success of an apiary, that it should be in a neighbourhood where the bees can be supplied with an abundance of good pasturage, as upon that will depend the fecundity of the queen and the harvest of wax and honey.

If *Dutch clover* (*Trifolium repens*) be neither grown abundantly by the neighbouring farmers, nor the spontaneous growth of the surrounding country, the apiarian should, if possible, crop some ground with it himself, as it is one of the grand sources from which bees collect their honey in the spring, and indeed during a considerable portion of the principal gathering season. From the value of clover in this respect, one species of it (*Trifolium pratense*) has acquired the name of Honey-suckle clover. *Yellow trefoil* also (*Medicago lupulina*), though not so great a favourite with the bees as Dutch clover, is nevertheless a valuable pasturage for them, in consequence of its blossoming earlier than the clover.

Though I have made Dutch clover take precedence of every other bee pasturage,—a precedence which in this country at least it is fairly entitled

to,—yet it is by no means the first in the order of the seasons.

“First the gray willow’s glossy pearls they steal,  
Or rob the hazel of its golden meal,  
While the gay crocus and the violet blue  
Yield to the flexile trunk ambrosial dew.” EVANS.

The earliest resources of the bee are *the willow, the hazel, the osier, the poplar, the sycamore and the plane*, all which are very important adjuncts to the neighbourhood of an apiary. The catkins of several of them afford an abundant supply of farina, and attract the bees very strongly in early spring when the weather is fine. Mr. Kirby, in his *Monographia Apum Angliæ*, considers the *female* catkins of the different species of *Salix* as affording honey, the *male* ones, pollen.

To these may be added *the snowdrop, the crocus, white alyssum, laurustinus, &c.*

*Orange and lemon trees* also, and other *green-house plants*, afford excellent honey, and might be advantageously presented to the bees at this season.

*Gooseberry, currant and raspberry trees* likewise, with *sweet marjoram, winter savory and peppermint*, should not be far off them. From the early blossoming of the two first, and from their yielding an extraordinary quantity of honey, they form some of the first sources of spring food for

the bees, and in all probability furnish them with the pale green pellets, then seen upon their thighs.

*The peach, nectarine, &c.* are also valuable, on account of their blossoming very early.

*Apple and pear trees*, which in Worcestershire and Herefordshire, during several weeks of spring, seem to form

“ One boundless blush, one white empurpled shower  
Of mingled blossoms,”

and give those counties the appearance of a perfect paradise, “ may be said to constitute a second course for the bees, after their earlier spring feast on the bloom of the currants, gooseberries, and all the varieties of wall fruit.”

*Alder buds and flowers* are also particularly grateful to bees; the former are said to afford honey for six months together. The maple and the lime also afford it for a considerable time.

Dickson, in his “Agriculture,” states that the blossoms of *the bean*, which are highly fragrant, though affording but a scanty supply of honey, are nevertheless frequented by crowds of bees. “Is this,” says Dr. Evans, “an instance of mistaken instinct?”

The young spotted leaves of *the vetch* (*Anthyllis vulneraria*) they likewise ply continually for three months together, as well as its flowers, even though very distant from their homes. The beans also

which prove most attractive to them are those with spotted leaves.

From the partiality of these natural chemists for the spotted leaves of the vetch and bean, I suspect that the spotting originates from disease, which causes those leaves to throw out a honeyed secretion. In this opinion I am strengthened by what Mr. Hubbard has stated, in a paper presented to the Society of Arts for 1799, respecting papilionaceous plants. "It is not," says he, "from the flower, but a small leaf, with a black spot on it, which, in warm weather, keeps constantly oozing, that the bees gather their honey." Mr. Hubbard also assures us in the same paper that *the tare* (*Ervum hirsutum et tetraspermum*) is highly useful to bees; and that several acres, sown near his apiary, otherwise badly situated, rendered it very productive.

*Turnips, mustard, and all the cabbage tribe* are also important auxiliaries; their culture is strongly recommended by Wildman, as affording spring food to the bees. In the autumn a field of *buckwheat* becomes a very valuable resource for them, from its prolonged succession of bloom. Buckwheat flowers in bunches, which contain ripe seeds in one part, while blossoms are but just opening in another. Huber has given his testimony in favour of this black grain, and Worlidge says that he has known the bees of a very large apiary fill the combs with

honey in a fortnight, in consequence of being placed near a large field of buckwheat. Bees indeed like to have every thing upon a large scale ; whole fields of clover, beans, the brassica tribe and buckwheat, as has been just observed, attracting them much more strongly than scattered plants, though affording finer honey, such as creeping lemon thyme, mignonette, &c.

Some flowers they pass by, though yielding a considerable quantity of honey : those of the honeysuckle for instance, though much frequented by the humble-bee, are never visited by the hive-bee, the superior length of the proboscis of the former enabling it to collect what is quite out of the reach of the latter. Every flower of the trumpet honeysuckle (*Lonicera sempervirens*), if separated from the germen, after it is open, will yield two or three drops of pure nectar.

In the Transactions of the Society of Arts for 1789, Mr. John. Lane speaks of the fondness of bees for *leek blossoms*, and says that he raised leeks extensively for their use.

“ Your bees will rejoice,” says Mr. Isaac, “ when they see the neighbourhood variegated by the blossoms of *sunflowers*, *hollyhocks* and *Spanish broom*, and even the *dandelion*, which embellishes the garden of the sluggard.” Dr. Evans observed that bees not only collect farina from the numerous assemblage of anthers in the flower of the holly-

hock, but a balsamic varnish also, (most likely propolis,) from the young blossom buds, and says he has seen a bee rest upon the same bud for ten minutes at least, moulding the balsam with its fore feet and transferring it to the hinder legs. An elegant modern writer, speaking of the fondness of bees in general for the flowers of the hollyhock, observes that "it has been held a gross libel upon animals to say, that a man has made a beast of himself, when he has drunk to such excess as to lose his reason; but we might without injustice say, that he has made a humble-bee of himself, for those little debauchees are particularly prone to intoxication. Round the nectaries of hollyhocks, you may generally observe a set of determined toppers quaffing as pertinaciously as if they belonged to Wilkes's club; and round about the flower, (to follow up the simile,) several of the bon-vivants will be found lying on the ground inebriated and insensible." I have frequently seen the ground beneath [one of my pear-trees strewed over with hive-bees and wasps, in a similar state, after they had banqueted upon the rich juices of the fallen fruit. Mr. Kirby, in his *Monographia Apum Angliæ*, observes that the male humble-bees, when the thistles are in bloom, are often seen asleep or torpid upon its flowers, and sometimes acting as if intoxicated with the sweets they have been imbibing.

*The holly, the privet, phillyrea, elder and common bramble*, together with *sweet fennel, nasturtiums* and *asparagus*, are also much frequented by the bees. They are likewise very partial to the yellow flowers of *the crowfoot*, as well as to the flowers of *the dead nettle*, especially the white.

The blossoms of *the cucumber, gourd and vegetable marrow* also, yield a considerable quantity both of honey and farina, as do likewise those of the *white lily*.

“ Apes æstate serenâ  
Floribus insidunt variis, et candida circum  
Lilia funduntur.” VIRGIL.

Dr. Evans speaks of the *Cacalia* or *Alpine coltsfoot* as affording a great quantity of honey, the scent of which is often diffused to a considerable distance; and Dr. Darwin, in a note to his “*Botanic Garden*,” mentions having counted on one of those plants, besides bees of various kinds, upwards of two hundred painted butterflies, which gave it the appearance of being loaded with additional flowers.

“When o’er her nectar’d couch papilios crowd,  
And bees in clusters hum their plaudits loud.” EVANS.

“What is it,” says the anonymous writer whom I lately quoted, “that brings the bees buzzing round us so busily? See, it is this tuft of colts-foot, which they approach with a harmonious

chorus, somewhat like the *Non nobis, Domine*, of our singers; and after partaking silently of the luxurious banquet, again set up their tuneful Pæans."

Ornamental flowers, such as roses, ranunculuses, anemones, pinks and carnations, afford little or no pabulum for bees, and tulips are probably pernicious to them, dead bees being frequently found in their flowers.

It would be a great acquisition to the bees to have near them a large plantation of *borage*, which affords peculiarly delicate honey, as does also *viper's bugloss*. The former continues blooming for many months, and, bearing a pendant flower, it is not liable to be washed by rain; *mignonette* too, if sown abundantly, is a plant of considerable importance to the apiary, and for a somewhat similar reason,—its continuing in bloom till the autumnal frosts set in, and its yielding honey of peculiar whiteness and delicacy. Instances have been known, of an abundant crop of these two flowers affording a large supply of honey to the apiary, near which they were sown, when, at the same time, there was a general failure of all the neighbouring stocks.

*Lemon thyme* should be planted in every beegarden, wherever room can be afforded for it: it blossoms late, (the beginning of August,) and affords very fine flavoured honey. It might be advantageously used as an edging for garden walks

and flower-beds, instead of box ; some use thrift and daisies for the same purpose. Box has the character of giving honey a bitter flavour, and Pliny has observed that the Romans, in laying tribute upon Corsica, exacted from the inhabitants two hundred pounds of wax, but wholly excepted honey, on account of its being flavoured by the box-tree.

*The common teasel* (*Dipsacus sylvestris*) should have a place near every bee-house, as it not only supplies honey from its rich purple heads, but yields a seasonable supply of water, in the cups formed by the leaves at every joint of the stem, which contain from a spoonful to half a pint of water. This convenience is still more efficiently supplied by the large floating leaves of *the water lily*, which should if practicable be introduced near every apiary. As should also *the great hairy willow-herb* (*Epilobium hirsutum*), a very ornamental though a very common plant, growing by the sides of rivulets.

*Furze, broom, heath and saintfoin*, are good neighbours to an apiary. The blossoms of furze so abound with honey as to be pervaded strongly by the scent of it, and the broom has been extolled ever since the days of Pliny. Mr. Bradley speaks in the highest terms of its blossoms, as affording a great quantity of honey ; but he greatly prefers the Spanish broom, and says that an acre of it

would maintain ten stocks. The culture of saint-foin as a bee-pasture is also well worthy of the apiarian's attention in some situations; for though it flourishes best in a calcareous soil, it will thrive in soils which are too poor either for grass or tillage. Furze and broom are particularly serviceable on account of their blossoming early and long, and abounding in farina.

On the other hand, the lateness of its bloom makes *ivy* a very valuable resource for the bees. On a fine day at the end of October, among the ivy-mantled towers of an old castle, I have heard their humming noise, so loud as scarcely to be exceeded by that which they make, among the trees affected with honey-dew, in summer. I should however conceive that the ivy blossom is principally serviceable as affording pollen, which the bees probably warehouse, for feeding the young larvæ in the ensuing spring. Mr. Hunter recommends St. John's wort (*Hypericum perforatum*), which also comes in late, as a favourite plant for collecting pollen, for winter's store. This stored pollen is used for feeding the earliest hatched larvæ, though it is evident that the bees prefer fresh for the purpose, from their collecting it as early in the spring as possible, and from the quantity of stored pollen that is found in every old hive.

*Commons surrounded by woods* are well known

to make an apiary productive, the commons abounding with wild thyme and various other flowers, which the scythe never touches ; and the trees, in addition to their farina, affording in some seasons a profusion of honey-dew. The forwardness and activity of hives thus situated, may, in part, be attributed to the sheltering protection of the woods.

Keys says he never observed bees to be particularly fond of the wild thyme. In this he is opposed to almost all the authors who have written upon the subject. Theophrastus, Pliny, Varro, Columella, and various other writers, speak in the highest terms of it. The Abbé Barthelemy speaks thus of bees. "These insects are extremely partial to Mount Hymettus, which they have filled with their colonies, and which is covered almost every where with wild thyme and other odoriferous plants ; but it is chiefly from the excellent thyme the Mount produces, that they extract those precious sweets, with which they compose a honey in high estimation throughout Greece."

" Here their delicious task the fervent Bees,  
In swarming millions, tend : around, athwart,  
Through the soft air the busy nations fly,  
Cling to the bud, and, with inserted tube,  
Suck its pure essence, its ethereal soul ;  
And oft with bolder wing, they soaring dare

The purple heath, or where the wild thyme grows,  
And yellow load them with the luscious spoil."

THOMSON.

That flowers impart a portion of their flavour to honey, seems to be generally admitted, though probably not so much as some have imagined. It is not to be supposed that the bee confines itself, in this country at least, to a few particular flowers,—it ranges through a great variety; excellent honey has been produced where the bees had little access to any flowers but those of nettles and other weeds.

Still however the balm of Pontus, the thyme of Hymettus, and the rosemary of Narbonne, are generally supposed, from their aromatic flowers, to give its peculiar excellence to the celebrated honey of those places.

It should seem therefore that *rosemary* might prove of importance in the neighbourhood of an apiary, by improving the quality and increasing the quantity of honey in certain seasons, viz. if the weather were very hot and dry, when it blossomed; for it never affords much honey in this country, excepting in such a season. It blossoms the earliest of aromatic herbs, and should of course be planted in a southern aspect.

Having said thus much upon the power which flowers possess of imparting a peculiar flavour to

the honey which is extracted from them, I will now advert to what has been stated relative to their impregnating it with deleterious qualities. During the celebrated retreat of the ten thousand, as recorded by Xenophon in his *Memorabilia*, the soldiers sucked some honey-combs in a place near Trebizonde, where was a great number of beehives, and in consequence became intoxicated, and were attacked with vomiting and purging. He states that they did not recover their senses for twenty-four hours, nor their strength for three or four days. Tournefort, when travelling in Asia, bearing in mind this account of Xenophon, was very diligent in his endeavours to ascertain its truth, and had good reason to be satisfied respecting it. He concluded that the honey had been extracted from a shrub growing in the neighbourhood of Trebizonde, which is well known to produce the before-mentioned effects, and even to disturb the head by its odour. From his description and that of others, the plant from which this honey was extracted, appears to be the *Rhododendron ponticum* or *Azalea pontica* of Linnæus, both nearly allied to each other, and growing abundantly in that part of the country. The smell resembles honey-suckle, but is much stronger. Father Lamberti confirms Xenophon's account, by stating similar effects to have been produced by the

honey of Colchis or Mingrelia, where this shrub is also common.

Dr. Darwin, in his "Temple of Nature," states that some plants afford a honey which is intoxicating and poisonous to man, and that what is afforded by others is so injurious to the bees themselves, that sometimes they will not collect it. And Dr. Barton, in the American Philosophical Transactions, has stated that, in the autumn and winter of 1790, the honey collected near Philadelphia proved fatal to many, in consequence of which, a minute inquiry was instituted under the direction of the American Government, when it was ascertained satisfactorily, that the fatal honey had been chiefly extracted from the flowers of the *Kalmia latifolia*. Still more recently, two persons at New York are said to have lost their lives by eating wild honey, which was supposed to have been gathered from the flowers of the dwarf laurel, a thriving shrub in the American woods. I shall resume this subject in Chap. 24, on Bee-maladies.

It appears also that at the time of the inquiry set on foot by the American Government, similar fatal consequences were produced among those who had eaten the common American pheasant, which, on examination, was found to arise from the pheasants having fed upon the leaves of the

same plant *Kalmia latifolia*. This led to a public proclamation prohibiting the use of the pheasant for food during that season.

As most of the plants here enumerated are now introduced into our gardens, they might be supposed to injure the British honey. Most probably, however, their proportion to the whole of the flowers in bloom is too small to produce any such inconvenience; whereas on their native continent they exclusively cover whole tracts of country.

I cannot close this chapter on Bee-Pasturage, without adverting to what Linnæus has said of the *Fritillaria imperialis* or *crown imperial*, and of the *Melianthus* or *honey-flower*. Of the former, he observes that "no plant, melianthus alone excepted, abounds so much with honey, yet the bees do not collect it." Of the latter he remarks "that if it be shaken, whilst in flower, it distils a shower of nectar." This observation applies more particularly to the *Melianthus major*. And with respect to the *Fritillaria*, Dr. Evans says, "that the bees do sometimes visit it; and he thinks that they would do so oftener, but for the disagreeable fox-like smell that emanates from it."

The *liquidambar* and *liriodendrum* or *tulip-tree*, both which are so ornamental, the former to our shrubberies and the latter to larger plantations, have been much extolled, as affording food for

bees. The liquidambar bears bright saffron-coloured flowers, and highly perfumed and glossy leaves, and its whole rind exudes a fragrant gum. The liriodendrum is crowned with large bell-shaped blossoms, of every rainbow hue, which give it a very splendid appearance.

## CHAPTER V.

## HONEY-DEW.

THE term HONEY-DEW is applied to those sweet clammy drops that glitter on the foliage of many trees in hot weather. The name of this substance would seem to import, that it is a deposition from the atmosphere, and this has been the generally received opinion respecting it, particularly among the ancients; it is an opinion still prevalent among the husbandmen, who suppose it to fall from the heavens: VIRGIL speaks of "*Aërii mellis cœlestia dona:*" and PLINY expresses his doubts, "*sive ille est cœli sudor, sive quædam siderum saliva, sive purgantis se aëris succus.*" The Rev. GILBERT WHITE, in his *Naturalist's Calendar*, regards honey-dew as the effluvia of flowers, evaporated and drawn up into the atmosphere by the heat of the weather, and falling down again in the night with the dews that entangle them. But if this were the case, the fall would be indiscriminate, and we should not have it confined to particular trees and shrubs, nor would it be found upon green-house and other covered plants. Some naturalists have regarded honey-dew as an exudation or secretion from the surface of those leaves upon which it is found, produced by some atmo-

spheric stroke, which has injured their health. Dr. DARWIN stands in this class. Others have viewed it as a kind of vegetable perspiration, which the trees emit for their relief in sultry weather ; its appearance being never observed in a cold ungenial summer. Dr. EVANS is of this opinion, and makes the following comparative remark : “ As the glutinous sweat of the negro enables him to bear the fervours of his native clime, far better than the lymph-perspiring European ; so the saccharine dew of the orange, and the fragrant gum of the Cretan cistus, may preserve them amidst the heats even of the torrid zone.” Mr. CURTIS has given it as his opinion that the honey-dew is an excrementitious matter, voided by the aphis or vine-fretter, an insect which he regards as the general cause of what are called blights. He assures us that he never, in a single instance, observed the honey-dew unattended with aphids.

I believe it will be found that *there are at least two sorts of honey-dew ; the one a secretion from the surface of the leaf*, occasioned by one of the causes just alluded to, *the other a deposition from the body of the aphis*. Sir J. E. SMITH observes of the sensible perspiration of plants, that “ when watery, it can be considered only as a condensation of their insensible evaporation, perhaps from some sudden change in the atmosphere. Groves of

poplar or willow exhibit this phenomenon, even in England, in hot calm weather, when drops of clear water trickle from their leaves, like a slight shower of rain. Sometimes this secretion is of a saccharine nature, as DE LA HIRE observed in orange trees." "It is somewhat glutinous in the tilia or lime tree, rather resinous in poplars, as well as in *Cistus creticus*." "Ovid has made an elegant use of the resinous exudations of Lombardy poplars, which he supposes to be the tears of Phaëton's sisters, who were transformed into those trees. Such exudations must be considered as effusions of the peculiar secretions; for it has been observed that manna may be scraped from the leaves of *Fraxinus ornus*, as well as be procured from its stem by incision. They are often perhaps a sign of unhealthiness in the plant; at least such appears to be the nature of one kind of honey-dew, found in particular upon the beech, which, in consequence of an unfavourable wind, has its leaves often covered with a sweet exudation, similar in flavour to the liquor obtained from its trunk. So likewise the hop, according to LINNÆUS, is affected with the honey-dew, and its flowers are rendered abortive, in consequence of the attacks of the caterpillar of the Ghost moth (*Phalæna Humuli*) upon its roots. In such case the saccharine exudation must decidedly be of a morbid nature."

The other kind of honey-dew which is derived from the aphids, appears to be the favourite food of ants, and is thus spoken of by Messrs. KIRBY and SPENCE, in their late valuable Introduction to Entomology. "The loves of the ants and the aphides have long been celebrated; and that there is a connexion between them you may at any time in the proper season, convince yourself; for you will always find the former very busy on those trees and plants on which the latter abound; and if you examine more closely, you will discover that the object of the ants, in thus attending upon the aphides, is to obtain the saccharine fluid secreted by them, which may well be denominated their milk. This fluid, which is scarcely inferior to honey in sweetness, issues in limpid drops from the abdomen of these insects, not only by the ordinary passage, but also by two setiform tubes placed, one on each side, just above it. Their sucker being inserted in the tender bark, is without intermission employed in absorbing the sap, which, after it has passed through the system, they keep continually discharging by these organs. When no ants attend them, by a certain jerk of the body, which takes place at regular intervals, they eject it to a distance." The power of ejecting the fluid from their bodies, seems to have been wisely instituted to preserve cleanliness in each individual fly, and indeed for the preserva-

tion of the whole family ; for pressing as they do upon one another, they would otherwise soon be glued together, and rendered incapable of stirring. “ When the ants are at hand, watching the moment at which the aphides emit their fluid, they seize and suck it down immediately : this however is the least of their talents ; for the ants absolutely possess the art of making the aphides yield it at their pleasure ; or in other words of milking them.” The ant ascends the tree, says Linnæus, *that it may milk its cows the aphides*, not kill them. Huber informs us that the liquor is voluntarily given out by the aphis, when solicited by the ant, the latter tapping the aphis gently, but repeatedly with its antennæ, and using the same motions as when caressing its own young. He thinks, when the ants are not at hand to receive it, that the aphis retains the liquor for a longer time, and yields it freely and apparently without the least detriment to itself, for even when it has acquired wings, it shows no disposition to escape. A single aphis supplies many ants with a plentiful meal. The ants occasionally form an establishment for their aphides, constructing a building in a secure place, at a distance from their own city, to which, after fortifying it, they transport those insects, and confine them under a guard, like cows upon a dairy farm, to supply the wants of the metropolis. The aphides are provided with a hollow pointed

proboscis, folded under the breast, when the insects are not feeding, with which instrument they puncture the turgid vessels of the leaf, leaf-stalk or bark, and suck with great avidity their contents, which are expelled nearly unchanged, so that however fabulous it may appear, they may literally be said to void a liquid sugar. On looking steadfastly at a group of these insects (*Aphides Salicis*) while feeding on the bark of the willow, their superior size enables us to perceive some of them elevating their bodies and emitting a transparent substance in the form of a small shower.

“ Nor scorn ye now, fond elves, the foliage sear,  
When the light aphids, arm'd with puny spear,  
Probe each emulgent vein till bright below  
Like falling stars, clear drops of nectar glow.”

EVANS.

The *willow* accommodates the bees in a kind of threefold succession, the farina of the flowers yielding spring food for their young,—the bark giving out propolis for sealing the hives of fresh swarms,—and the leaves shining with honey-dew in the midst of summer scarcity. But to return to the aphides. “ These insects may also be seen distinctly, with a strong magnifier, on the leaves of the hazel, lime, &c. but invariably on the inferior surface, piercing the vessels, and expelling the honey-dew from their hinder parts with considerable force.” “ These might easily have es-

caped the observation of the earlier philosophers, being usually concealed within the curl of the leaves that are punctured." The drops that are spurted out, unless intercepted by the surrounding foliage, or some other interposing body, fall upon the ground, and the spots may often be observed, for some time, beneath the trees affected with honey-dew, till washed away by the rain. When the leaves of the kidney-bean are affected by honey-dew, their surface assumes the appearance of having been sprinkled with soot.

Honey-dew usually appears upon the leaves, as a viscid, transparent substance, sweet as honey, sometimes in the form of globules, at others resembling a syrup, and is generally most abundant from the middle of June to the middle of July.

It is found chiefly upon the *oak*, the *elm*, the *maple*, the *plane*, the *sycamore*, the *lime*, the *hazel* and the *blackberry*; occasionally also on the *cherry*, *currant*, and other fruit trees. Sometimes only one species of trees is affected at a time. The oak generally affords the largest quantity. At the season of its greatest abundance, the happy humming noise of the bees may be heard at a considerable distance from the trees, sometimes nearly equalling in loudness the united hum of swarming. Of the *plane* there are two sorts; the *oriental* and the *occidental*, both highly ornamental trees, and

much regarded in hot climates for the cooling shade they afford.

“Jamque ministrantem Platanum potantibus umbram.”

VIRGIL.

The ancients so much respected the former that they used to refresh its roots with wine instead of water, believing, as Sir William Temple has observed, that “this tree loved that liquor, as well as those who used to drink under its shade.”

“Crevit et affuso latior umbra mero.” VIRGIL.

The *sycamore* has been discarded from the situation it used formerly to hold, near the mansions of the convivial, owing to the bees crowding to banquet on its profusion of honey-dew, and occasioning an early fall of its leaves. The *lime* or *linden* tree has been regarded as doubly acceptable to the bees, on account of its fragrant blossoms and its honey-dewed leaves appearing both together, amidst the oppressive heats of the dog-days; but it seems doubtful whether the flowers have any attraction but their fragrance, as they are said to have no honey-cup.

It is of great importance to apiarians who reside in the vicinity of such trees as are apt to be affected with honey-dew, to keep their bees on the storifying plan, where additional room can at all times be provided for them at pleasure, as

during the time of a honey-dew, more honey will be collected in one week than will be afforded by flowers in several. So great is the ardour of the bees on these occasions, and so rapid are their movements, that it is often dangerous to be placed betwixt the hives and the dews.

That species of honey-dew which is secreted from the surface of the leaves, appears to have been first noticed by the ABBE BOISSIER DE SAUVAGES. He observed it upon the old leaves of the holm-oak and upon those of the blackberry, but not upon the young leaves of either ; and he remarked at the same time, that neighbouring trees of a different sort were exempt from it : among these latter he noticed the mulberry tree, "which," says he, "is a very particular circumstance, for this juice" (honey-dew) "is a deadly poison to silk-worms."

Some years do not afford any honey-dew, it generally occurs pretty extensively once in four or five years.

## CHAPTER VI.

## PURCHASE OF BEES.

EVERY one who meditates the establishment of an apiary, should be able to distinguish a good from a bad hive of bees, that he may detect imposition, if it should be attempted, when he is purchasing his first swarms or stocks. Bees are commonly purchased in the spring or in the autumn. The value of a hive of bees, purchased in the spring, if it be a recent swarm, may be ascertained by its weight, which should not be less than four or five pounds, on the day of swarming. But the weight *alone*, of a *stock* hive, is not a criterion of its worth; several other circumstances are to be considered,—for the worst *stock* hives often weigh the heaviest. Still if a stock hive be a swarm of the current year, which is always desirable, weight may be regarded *in a great* degree, as a *criterion of value*, its quantity of heterogeneous matters being probably inconsiderable. Such a hive, purchased in the autumn, should not weigh less than from twenty-five to thirty pounds, and should contain about half a bushel of bees.

There are surer grounds, however, upon which its value may be determined.

1st. The combs should be of a pale colour, as dark ones denote age; though even in this there may be deception, for old combs may be lengthened out and bordered with new wax.

2dly. The combs should be worked down to the floor of the hive.

3rdly. The interstices of the combs should be crowded with bees.

All these points may be safely ascertained, by gently turning up the hive in an evening, when the bees are at rest. It may be well also to notice the proceedings of the bees in the day-time. If when they quit the hive, to range the fields, they depart in quick succession and without lingering about; and if the entrance be well guarded by sentinels; these are pretty sure indications of a prosperous hive.

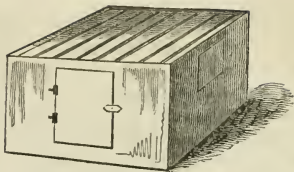
The hive, when purchased, should be raised gently from the stool, some hours prior to its removal, and be supported by wedges, that the bees may not cluster on the floor, as this would be productive of inconvenience at the time of their removal. After being wedged up, the hive should remain undisturbed till night, when, being placed upon a proper board, it should be carried away carefully, and placed at once where it is intended to remain, unless it be a recent swarm which is to be removed into a box.—The mode of proceeding in this case will be noticed hereafter.

The bees of a hive, recently removed, if purchased of a near neighbour, or if the weather be cold, should be confined for a day or two, or else many of them, after flying about in quest of provision, will be lost; in the one case, by returning to their old habitation, and in the other, by being chilled to death, in searching for their new one.

## CHAPTER VII.

## BEE-BOXES.

THERE has been some difference of opinion as to *the most suitable dimensions of bee-boxes*. I prefer those of Keys, which are twelve inches square and nine inches deep, *in the clear*. The *best wood* for them is *red cedar*, the fragrance of which is regarded by some as agreeable to the bees ; but the chief grounds of preference are its effect in keeping moths out of the boxes, and its being a bad conductor of heat, from its lightness and sponginess. Whatever kind of wood be made use of, it should be well seasoned ; *yellow deal* answers the purpose very well. The sides of the boxes should be an inch thick, and the bars on the top three quarters of an inch, about an inch and half wide, and six in number, which will leave an interspace between each of about half an inch. At the back of each box, a pane of glass should be fixed in a small rabbet, which may be covered with a half inch door, hung with wire hinges and fastened by a button.



The size of the door may be suited to the wishes of the apiarian : as this door will only give a view of the centre combs, in case of their being constructed in a line with the bars, or of one or more of the external combs, in case of their being attached at right angles with the bars or diagonally, it will be desirable to have a pane of glass in each side also, that the proprietor may be enabled to judge at any time of the stock of honey contained in the box. These small glass windows will seldom do more than afford the proprietor an opportunity of ascertaining the strength of his stock of bees, and the quantity of honey they have in store ; if he wish to see more particularly the operations of the labourers, or to witness the survey which the queen now and then takes of them, he may have a large bell-glass, surmounted by a straw-hive, which latter may be occasionally raised, for the purpose of inspection.

“ By this blest art our ravish'd eyes behold,  
The singing Masons build their roofs of gold,

And mingling multitudes perplex the view,  
Yet all in order apt their tasks pursue;  
Still happier they, whose favour'd ken hath seen  
Pace slow and silent round, the state's fair queen."

EVANS.

An opportunity of beholding the proceedings of the queen is so very rarely afforded, that many apiarians have passed their lives without enjoying it; and Reaumur himself, even with the assistance of a glass-hive, acknowledges that he was many years before he had that pleasure. Those who have been so fortunate, agree in representing her majesty as being very slow and dignified in her movements, and as being constantly surrounded by a guard of about a dozen bees, who seem to pay her great homage, and always to have their faces turned towards her, like courtiers, in the presence of royalty.

" But mark, of royal port, and awful mien,  
Where moves with measur'd pace the INSECT QUEEN!  
Twelve chosen guards, with slow and solemn gait,  
Bend at her nod, and round her person wait." EVANS.

Mr. Dunbar's observations, upon the movements of the queen in his mirror hive, do not correspond altogether with what is here stated. He says that he did not find her majesty attended in her progress by a guard, but that wherever she moved the way was cleared; that the heads of the workers whom she passed upon her route were always turned towards her, that they fawned upon

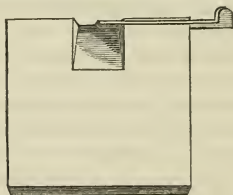
and caressed her, touching her softly with their antennæ ; but that as soon as she moved onwards, they resumed their labours, whilst all that she passed in succession paid her the same homage. This sort of *homage* is only *paid to fertile queens* ; whilst they continue virgins, they are not treated with much respect.

The queen is very numerously surrounded, when depositing her first eggs in the cells, her attendants then cling to one another and form a living curtain before her, so completely impenetrable to our eyes, as to preclude all observation of her proceedings ; unless the apiarian use the leaf-hive of Huber, or the mirror-hive of Dunbar, it is hardly possible to snatch a sight of her, excepting when she lays her eggs near the exterior parts of the combs. The manner in which bees attach themselves to each other, when forming a curtain, or when suspending themselves from a bough, or taking their repose, is, by each bee, with its two fore claws, taking hold of the two hinder legs of the one next above it, thus forming as it were a perfect grape-like cluster or living garland. Even when thus intertwined with each other, as Swammerdam has observed, they can fly off from the bunch, and perch on it again, or make their way out from the very centre of the cluster, and rush into the air. This mode of suspension, so voluntarily adopted, must be agreeable to them, though

the uppermost bees evidently bear the weight of all the rest. Mr. Wildman supposes that they have a power of distending themselves with air, like fishes, by which they acquire buoyancy.

Each set of boxes must have one *close cover*, which should be an inch thick and well clamped at each end to prevent warping, as a considerable quantity of steam arises from the bees at certain seasons. The top, being intended to take off and on, should be secured by means of four screws, each placed about an inch and a half from the respective corners; and it should also be fitted to, and screwed down upon, all the boxes before any of them are used, that whenever it may be necessary to remove, or to add a box, the change may be effected with the utmost promptitude. Long taper screws, as nearly of the same size as possible, should be selected for fastening on the tops, and be dipped in grease before put in, to facilitate their removal. Each set of boxes must also have a *loose floor*, an inch thick and extending about an inch and half beyond the back and sides of the boxes. The outlet for the bees is usually cut in the lower edge of the boxes, but I have found it much more convenient to have it formed by sinking the floor half of its thickness at the centre of its front edge. The width of the part sunk should be about four inches, and should gradually diminish in depth till it reach the centre

of the board. The sloping direction thus given will, in case of beating rain or condensed steam falling upon it, prevent any wet from lodging within the hive. The floor must also be clamped at the ends, to prevent warping, though the superincumbent weight renders it less liable to be warped than the top. Either on the right or left hand side of the entrance, as may be most convenient, a *groove* must be cut half an inch deep and half an inch wide; to this groove a *slide* must be fitted (made to run easily), for the purpose of closing the box, and preventing the egress or ingress of the bees, as occasion may require.



A *centre board* between each tier of boxes will likewise be convenient; it should be of the same size as the floor, and have an oblong hole about six inches by four in the middle, to give liberty to the bees to pass from box to box. Apiaries should always have a few supernumerary boards of each sort, and also some supernumerary boxes.

As the boxes and boards require to be made with great accuracy, that they may be nicely adapted to each other, a good joiner should be employed to construct them; for if there be any crevices the bees will, according to their invariable custom, fill them with propolis, and thereby waste their valuable time. The square boxes which I have described are the simplest of any, in their form: some persons prefer the octagon or hexagon form; in some situations, if windows be placed in the three posterior sides, those forms may be more convenient for exhibiting the operations of the bees, or the store of honey in the combs; but they are more expensive and more cumbrous, if made as capacious as the square ones; and these latter answer the intended purposes so well, as to satisfy completely those who have used them. Although I have endeavoured to give a clear description of the form and mode of constructing a bee-box and its appendages, probably it may be more satisfactory to young beginners to obtain a sight or a model of them, I refer them therefore to Mr. Hughes, joiner, Ross, Herefordshire, or to Mr. John Milton, 10, Great Marybone Street.

I cannot dismiss this part of my subject, without saying a few words respecting *the hive of Huish*, which is contrived with the view of allowing the removal of the exterior bars, that support the honey-combs, without disturbing the brood-

combs. The principle of this hive appears to be very good, but I doubt whether it will come into general use; for as bees are not very tractable creatures, they are not likely to construct their combs in direct lines, so as to attach one singly to each of Mr. Huish's bars: the tops of the boxes which I use are constructed like Huish's, yet I never saw an instance in which the combs did not either cross those bars at right angles, or connect themselves in some way or other with two or three bars, so as to render it impracticable to remove a comb or two from the outsides, in the manner that Huish proposes. The sole advantage of Huish's hive consists in this undisturbing mode of removal; and could it be effected, honey might be extracted without withdrawing any of the stored pollen or propolis, or molesting the brood in the centre combs; an inconvenience which, it must be admitted, may be charged upon the storifying system, though I hope I have, in my chapter on Deprivation, pointed out a method that will, in a very great degree, if not entirely, remedy this inconvenience. Huish, in his instructions for using his hives, admits the difficulty which I have here stated, as to the attachment of a single comb to more than one bar, and gives particular directions how to proceed on such occasions; but even under tolerably favourable circumstances, the recommended operation would

require considerable nicety, and no small portion of courage ; in some cases the difficulty would be completely insurmountable. A hive very similar to that of Huish is described in Wheeler's Travels. He states it to be in use in the neighbourhood of Mount Hymettus. "The hives," says he, "in which they keep their bees, are made of willow or osiers fashioned like our common dust-baskets, wide at top and narrow at bottom." "These tops are covered with broad flat sticks, along which the bees fasten their combs, so that a comb may be taken out whole." We are informed, by Reaumur and Du Hamel, that this Greek method of keeping bees and taking honey was introduced into France in 1754. If it had succeeded, either in France or in this country, I think we should have heard more of it.

The only way in which I conceive that Huish's idea can be followed up effectually, is, by employing the experimental hive of Huber ; but the majority of persons who undertake the management of bees, will look to them as a source of profit ; and to these the expense of such a hive would render it completely unavailable. Huber's first experiments were made in single leaf-hives an inch and a half wide ; his latter trials, on several of these connected together, each an inch and a quarter wide, which left the same room for the passage of the bees as the single hive. See Chap-

ter xi. Reaumur's hives consisted of wooden frames, with glass windows, but of such a width, as to allow the bees to construct two combs parallel to each other. This form is unfavourable, inasmuch as it conceals from the observer whatever passes between them.

Mr. Thorley, who practised the plan of super-hiving, surmounted his *octagon boxes* and flat-topped hives, with a *large bell-glass*, over which he placed a common straw hive, to take on and off. From an extract which I have made from Dr. Evans's book in the chapter on Instincts, he appears to have adopted this method.

It was by the aid of similar glasses that Maraldi was enabled to give to the world so accurate an account of the natural history and labours of bees.

“ Long from the eye of man and face of day,  
Involv'd in darkness all their customs lay,  
Until a Sage, well vers'd in Nature's lore,  
A genius form'd all science to explore,  
Hives well contriv'd in crystal frames dispos'd,  
And there the busy citizens inclos'd.”

MURPHY'S VANIERE.

Wildman also, in addition to his usual mode of keeping bees, upon the storifying plan, occasionally employed flat-topped hives surmounted by a large bell-glass; and at the close of his Treatise we are informed that he had latterly adopted

another method of super-hiving, which is still practised by apiarians of the present day. Instead of employing one large glass, he made use of *four or five small ones*, each holding about a pint; and those who are fond of using honey fresh from the hive, will find this a convenient mode of keeping their bees, though probably not so profitable a one as the general plan of storifying. A stock of these hives and glasses, on the most approved construction, is kept constantly ready for sale at Mr. John Milton's, 10, Great Marybone Street. The bees, upon this plan, are hived in the usual way, the top board being kept closed, till the glasses are placed over it, which may be done as soon as convenient after the hive has been put in the situation in which it is intended to remain. The glasses and top board should be covered with a common straw hive, to exclude the light, as bees are found to work best in the dark. When the glasses are sufficiently filled with combs and honey,—and this period will very much depend upon the season,—if the bees still remain in them, placing an empty hive under the full one will generally cause them to descend, and facilitate the removal of the glasses, which may take place as often as the harvest of honey will admit, consistently with the leaving of a full winter's supply for the bees. See chapter on Nadir-hiving. The usual mode of taking

the honey in these glasses is, first to cut off the communication between them and the hive on which they stand, by loosening the thumb-screw in the centre, and turning the board so far round as to close the openings; then, by means of a thin spatula, separating the glasses from their adhesion, and either carrying them, inverted, a short distance from the hive, into a shady place, or raising each glass by means of a wedge, and leaving it thus for about an hour. In either case the bees will quit the glasses and return to the family by the usual entrance. To effect the removal, I think it preferable to use two flat pieces of tin, after the manner of dividers, placing the tins successively under each glass, carrying it away upon one, and leaving the other over the opening till the glass has been emptied and replaced or another substituted in its room: and where it is wished to take only one or two glasses, this mode must always be adopted. The bees will rarely fill more than one set of glasses, during the first year; though in future years, if the season be favourable, they may be expected to fill two sets. The best time for removal is the middle of a fine day, when the greatest number of bees are roaming the fields. This method of management will not prevent the bees from swarming, unless it be combined with storifying, which it very easily may.

## CHAPTER VIII.

## HIVES.

BEE-HIVES have been formed with various materials, the selection of which has depended partly upon the country or district in which they have been used, and partly upon the fancy of the aparian. *Osiers, rushes, segs and straw* have all been in requisition for forming hives, and Bonner, an eminent bee-master in Scotland, proposes to have them made of *earthenware*. In North America, according to Brookes, they are formed out of *the hollow trunks of the liquidambar tree*, cut to a proper length and covered with a board to keep out the rain: for the same purpose the people in Apulia use *the trunk of the giant fennel*, after clearing away its fungous pith. In Egypt, says Hasselquist, bee-keepers make their hives of *coal dust and clay*, which being well blended together, is formed into hollow cylinders, of a span diameter, and from six to twelve feet long; these being dried in the sun, become so hard as to be handled at will. "I saw some thousands of these hives," says our author, "at a village between Damietta and Mansora; they composed a wall round a house, after having become unserviceable in the use they were first made for."—Voyages

and Travels in the Levant, &c. By Fred. Has-selquist, B.D.

Under the head of Storifying, I have given a history of the discovery and progressive improvement of boxes and storifying hives, and shall chiefly confine myself, in this chapter, to the form and dimensions of hives. The common bell-shaped straw hives used by the cottagers are too well known to need remark. Premising, therefore, that the *Chelmsford* and *Hertford hives* are considered as the handsomest shaped and best formed, I shall limit my observations to the *straw* hives which may be employed for storifying, as some persons may prefer straw to wood. These have been called *Moreton hives*, on account of their form *only*, the material of which they were made being reeds and not straw. The *best straw* for constructing hives is that of *unblighted rye*, and *unthrashed* is preferable to thrashed straw; for being smooth and entire, the bees will be spared a good deal of trouble, as they invariably nibble away the rough sharp spiculæ that they find on the inner surface of a new hive. The ears of corn may be dissevered from the straw by a chaff-cutter, and thrashed with other corn. The most approved size for a storifying straw hive is nine inches high by twelve inches wide, *in the clear*, the diameter being the same from top to bottom. The importance of having all bee-

boxes made of the same dimensions has been already dwelt upon, and it is of course of equal importance with respect to straw hives. The upper and lower edges should be made as smooth as possible; which effect will be greatly promoted, by placing them, soon after making, between two flat boards with a 56lb. weight upon the uppermost, and leaving them in that position for a day or two. Within the upper row of straw, a small hoop should be worked, for the purpose of nailing a board or some wooden bars to it, and within the bottom row a piece of wood should also be worked over the part where the bees are to pass in and out, to allow of a more easy movement of the slide in the floor-board. It would be an improvement if the hoop were perforated through its whole course with a wimble bit, that it might be stitched with willow or bramble splits, to the upper round of straw, instead of being worked in with it; and if a hoop were also stitched in a similar manner to the lower round of straw, the lower edge of it could be planed, sufficiently smooth, to lie on the middle or floor boards, as closely as a box, which would render the use of mortar or other luting unnecessary. The stitch holes in the hoop should be filled with putty, after the hive has been finished. If bars be made use of, they should be of the same width, and placed at the same distances from each other, as recom-

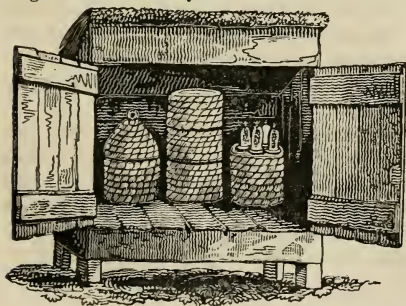
mended for the boxes, and the vacancies, that would otherwise be left between the ends of the bars, should be made quite level, with bits of wood, cow-dung, or any other convenient substance. If a single board be used, that, of course, must be cut into bars of the proper widths. The direction of the bars should always be from front to back.

Middle boards and floors will be equally required for storifying hives as for boxes; but the outside covers should be made of straw, like round mats, and be wide enough to extend an inch beyond the edges of the hives, if used in an out-door apiary. The whole story should be covered with a good *hackel* or *cap*, secured in its place by an iron hoop or a properly weighted wooden one, to prevent it from being blown down. As clean fresh rye straw is most suitable for constructing the hive itself, so it will be the best for forming the *hackel* with: the latter should be changed before it begins to decay, that it may not become offensive to the bees from its odour, nor be selected by insects as a nidus for their eggs.

The apiarian, if he be desirous of having glass windows in his straw hives, may accomplish this object by cutting with a sharp knife through two of the bands of straw, in two places, about three inches asunder. The windows are generally cut opposite the entrance, and about the centre, but

may be made at any part of the hive. The ends of the cut straw-bands may be secured by stitches of packthread, or, what is better, with softened mole snap wire, and the panes of glass may be fastened with putty.

Out-door hives should have a protection not only of straw caps, but of *a shed* also, which if made open in *front only*, would afford much shelter against driving rains and high winds; but the most complete shed is made with folding or sliding doors *at the back*, and is closed at the sides, and in front, with the exception of such openings as may be necessary for the entrance of the bees and for their accommodation in bad weather. This shed renders hackels unnecessary, and is adapted either to storifying or single hiving. In the annexed plate is a back view of it, with hives arranged in different ways.



## CHAPTER IX.

COMPARATIVE ADVANTAGES OF WOODEN  
BOXES AND STRAW HIVES.

MOST of the writers who have instituted a comparison between hives and boxes, have decided in favour of the former. But it is to be recollected that when forming this decision, these writers have always had in their minds an out-door apiary, for which situation, on account of their exposure to the variations of temperature and the alternations of drought and moisture, straw hives possess advantages over wooden boxes;—they are not so soon affected by a hot and dry or by a moist atmosphere; they do not part with so much heat in winter nor admit so much in summer, straw being, in the language of the chemists, a bad conductor of heat. Being much cheaper than any others, straw hives are of course chosen by the cottager.

Upon the storifying system, and with the advantage of a bee-house, I think wooden boxes have a great superiority over straw hives; they are more firm and steady, better suited for observing the operations of the bees through the glass windows in the backs and sides, and less lia-

ble to harbour moths, spiders, and other insects ; they permit the combs, at the period of deprivation, to be more easily separated from the sides and tops, and if well made, have a much neater appearance than straw hives.

## CHAPTER X.

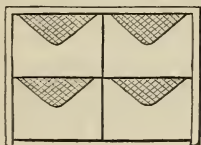
## LEAF HIVES.

NARROW hives, with large glazed doors on each side, have been recommended by apiarian writers, for exposing the operations of bees. That of REAUMUR was too wide: it allowed the construction of two parallel combs, by which of course, the apiarian was precluded from making any useful observations, upon the proceedings of the bees, in their interspace. BONNET recommended the use of a hive, the doors of which should be only so far asunder as to allow the building of one comb between them. This suggestion was successfully adopted by HUBER; and to prevent the bees from building short transverse combs, instead of a single one, parallel to the sides of the hive, he laid the foundation himself, by fastening a piece of empty comb to the cieling of the box.

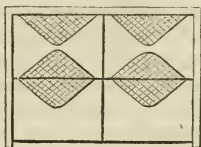
HUBER's glass doors had only an interspace of an inch and half betwixt them: in this hive the bees could not cluster upon the surfaces of the comb, and yet had room to pass freely over it. Mr. JOHN HUNTER recommended the diameter of these narrow hives to be three inches, and the superficies of the sides to be of sufficient size to

afford stowage for a summer's work. Mr. DUNBAR, with his *mirror hive*, constructed somewhat like Huber's, has been able to make some interesting observations on the œconomy of the bee. *Vide* Edinburgh Philosophical Journal, vol. iii. The distance of his glass doors from each other is one inch and two thirds; the height and width of the hive, according to the plan in the Journal, about a foot. Across the centre of the mirror hive Mr. Dunbar introduced a light frame, which though apparently dividing the hive into four compartments, allowed the bees a free passage: they were skreened from the light by a pair of folding shutters on each side.

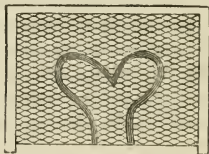
Mr. Dunbar hived a small swarm in one of these narrow boxes, in June 1819: the bees began to build immediately, and he witnessed the whole of their proceedings, every bee being exposed to his view. The narrowness of their limits constrained them, from the very commencement, to work in divisions, so that four separate portions of comb were begun and continued nearly at the same time.



But this arrangement did not sufficiently employ these industrious creatures; for contrary to their usual mode of building, which is from above downwards, they laid two other foundations of comb, upon the upper parts of the cross sticks.



The bees now wrought upwards and downwards at the same time, till the originally separate portions were united and become one comb.



For want of proper precautions, the bees of this hive perished, during the intense cold of January 1820.

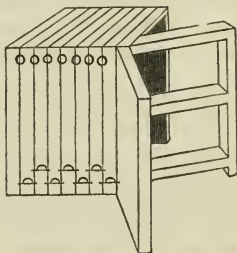
On the 25th of March following, Mr. Dunbar introduced another swarm into the same uncomb hive; and so early as the 27th, he saw the queen

laying the eggs of workers. This second swarm found plenty of honey and farina in the hive, left by its former tenants. Other particulars reported by Mr. Dunbar are detailed in the Chapters to which they belong.

These hives are of course only useful to the amateur apiarian, who is in quest of information or amusement.

Huber carried the principle of this hive still further: he joined several thin boxes together with hinges: these boxes or wooden frames were without glasses, and the hinges were so contrived as to admit of easy removal. Every box or leaf (as Huber called each separate frame), except the two exterior, was reduced in thickness to an inch and quarter, which, as there was a free communication between all the leaves, afforded the same liberty for the operations of the bees as the single box that was an inch and half wide. This contrivance gave him the power of opening the leaves separately, and inspecting the proceedings of the bees at all times: they soon became accustomed to this treatment, and M. Huber was thus able to examine any one of the divisions, without exciting the anger of the bees. After they had properly secured the pieces of comb which he had attached to the roofs of the boxes, they were subjected to a daily inspection by this indefatigable naturalist.

The preceding sketches may serve to show my readers the progressive proceedings of the bees in the uncomb hive, and the following outline may give them a notion of the compound hive.



## CHAPTER XI.

## DIVIDERS.

THE apiarian who adopts the storifying plan, should have *Keys's dividers*, which consist of two copper or brass plates, about the sixteenth of an inch thick, fifteen inches wide, and fifteen and a half long; the odd half inch, being turned up, serves for the operator to lay hold of, when the plates are withdrawn. Care should be taken that the plates be perfect planes, well hardened by hammering, and of proper thickness. If they exceed the prescribed thickness, the bees may escape as soon as the plates are partially introduced or partially withdrawn; and if they be thinner, there will be the same chance of escape from their want of firmness and elasticity.

These dividers greatly facilitate the various operations which the apiarian has to perform, and at the same time secure him from the attacks of the bees.

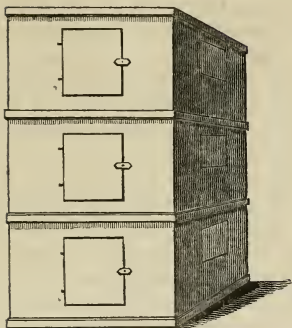
He should be provided with one of the *long-bladed spatulas* or knives, used by apothecaries and painters, which he will find useful in separating the honey-combs from the sides of the hives or boxes. In some cases it will also be necessary to have *an iron instrument*, about ten inches long

and half an inch wide, the end of which should be *turned up about two inches* and be *double-edged*, that it may cut both ways. This instrument, which should be fixed in a wooden handle, being passed between the combs, will enable the operator to separate them from their attachment to the bars.

Those who make use of the Moreton hives,—a description of which is given in the chapter on Hives,—should be furnished with two strips of tin four inches by fifteen; these will protect the straw bottoms of the upper hives during the introduction of the dividers, and should be introduced one on each side, the hives having been previously dissevered by means of the spatula.

## CHAPTER XII.

## STORIFYING.



STORIFYING means the piling of hives or boxes upon each other, as shown in the above plate, and preserving a free communication between them; a method which enables the apiarian to take wax and honey without destroying the lives of the bees.

Attempts have been made to accomplish this object in different ways. THORLEY placed empty hives or boxes over full ones, WILDMAN and KEYS placed full boxes over empty ones, WHITE and MADAME VICAT placed them collaterally.

Hives and boxes for storifying, as well as for observing the operations of the bees, have been made of various forms and dimensions, and of different materials: such as straw, osiers, glass, and wood.

ARISTOTLE, PLINY, and other ancient writers, speak of contrivances for taking honey, and inspecting the operations of the bees. Modern writers, particularly MOUFFET, ridiculed the ineffectual schemes of their brethren of antiquity, and indeed they were very soon abandoned. The way in which *they* endeavoured to accomplish their objects, was by the introduction of transparent substances into the sides of the hives or boxes, such as *isinglass*, *horn* (*cornu laterna*), *pellucid stone* (*lapis specularis*), probably *talc*, which is still used in the Russian navy for cabin windows, on account of its not being liable to break by the percussion of the air during the firing of cannon, or in tempestuous weather.

Mr. HARTLIB's *Commonwealth of Bees*, published in 1655, contains the first account, I have seen, of bee-boxes being employed in this country. He speaks of "an experiment of glassen hives invented by Mr. W. MEW, Minister of Easington in Gloucestershire: his boxes were of an octagon shape, and had a glass window in the back." Soon after, in the year 1675, JNO. GEDDE, Esq. published, "*A new discovery of an excellent method of Bee-houses and Colonies*," which was intended to

preserve the lives of the bees: he obtained a patent for his boxes from King Charles.

Gedde's boxes were considerably improved by JOSEPH WARDER, a physician at Croydon, who published an account of them in his work entitled "*The true Amazons, or the Monarchy of Bees.*" Dr. Warder enriched his account with several curious circumstances respecting bees; some of which will be detailed in a future chapter. The method of these gentlemen seems not to have been generally known; for even Swammerdam, who published in 1680, makes no mention of it. Had Swammerdam known it, he would have been informed of many circumstances, respecting which he was evidently ignorant. This want of Dr. Warder's information is to be lamented, for Swammerdam was an accurate observer, and a faithful reporter of what he did observe.

Gedde and Warder were succeeded by the Rev. JOHN THORLEY of Oxford, who published "*An Enquiry into the Nature, Order, and Government of Bees;*" and by the Rev. STEPHEN WHITE of Halton in Suffolk, who wrote on "*Collateral Bee-boxes, or an easy and advantageous method of managing Bees.*" Collateral boxes have been objected to, because bees, when the boxes are on a level, have laid their eggs promiscuously in both; moreover side boxes occupy a great deal more room than storifying boxes.

Mr. THORLEY'S SON improved the method of his father. The indefatigable Mr. WILDMAN devoted much of his time to the same subject: to him we are principally indebted for the present perfection of bee-boxes, and particularly for obtaining fresh honey throughout the season, by means of small glasses ranged upon a flat-topped hive. Vide pages 93 and 99.

“ But faintly, Rome, thy waxen cities shone  
Through the dim lantern or refractive stone,  
And faintly Albion saw her film-wing'd train  
Glance evanescent through the latticed pane,  
Ere Wildman's art unveil'd the straw-girt round,  
Its broad expanse with crystal vases crown'd,  
And each full vase, like Amalthæa's horn,  
For Man successive graced the festal morn.”

EVANS.

MADAME VICAT, a very ingenious lady in Switzerland, published, in the Memoirs of the Berne Society, some very judicious *Observations on bees and hives*. She was the first who hinted, that upon the storifying plan, the duplets and triplets should always be placed under the full hives; as the bees, in constructing fresh works, evidently prefer descending to ascending.

Lastly, we have Mr. KEYS'S very useful book, “*The ancient Bee-master's Farewell*,” which has long been a standard work to the practical apian.

Keys states, that upon the storifying plan, three pecks of bees will collect more honey in a season, than four pecks divided into two families, upon the common plan, and that the proportion of *pure* honey and *pure* wax will likewise be greater. He observes, that a good storified colony has, under favourable circumstances, received an accession of thirty pounds of honey in seven days ; whereas if a swarm had been sent off, the increase, in the same period, would not, probably, have been more than five pounds.

This difference of increase is owing, I conceive, to the divided family occupying a larger proportion of its workers as nurses, than the storified family employs, there being in the former the brood of two queens, in the latter the brood of only one, to be attended to. The one establishment is in fact divided, so as to form two establishments, and there must be of course, an observance of the accustomed peculiarities of dignity and office, in each of the two, as there was in the one ; consequently, fewer collecting bees can be spared from the divided family, than would have been at liberty in their undivided state ; and this reasoning will apply with increasing force as the number of duplets and triplets is increased.

In single hiving, if rainy weather occur at the time the bees are prepared to throw off a swarm, and the hive be filled with comb to its utmost

limit, all the bees must remain idle till the return of fine weather ; whereas if more room be given, as upon the storifying plan, they will, by embracing every opportunity for collecting, and by constructing fresh combs by means of the stores already collected, be enabled to diminish that check to their activity, which wet weather always occasions. Though rainy weather has this effect upon the bees, yet are they much less susceptible to moisture than to cold : they may frequently be seen in full activity upon a warm showery day, whereas on a cold dry one, they cluster closely together within the hives. The colder the weather the more closely they cluster. “ When the lime-tree and black grain blossom,” says Huber, “ they brave the rain, they depart before sun-rise, and return later than ordinary.”

Independently of the benefit derived from storifying, as congregating a numerous body of bees together, it will always be found advantageous to have hives of whatever sort well filled, as the bees uniformly work best when in a numerous body : this has induced Mr. Espinasse and others strongly to recommend the union of stocks that do not well fill the hives.

## CHAPTER XIII.

## SWARMING.

HOWEVER populous a stock of bees may be in the autumn, its numbers are greatly reduced during winter, perhaps about six or seven eighths. This loss is more than replaced in the spring, by the amazing fecundity of the queen. Hence arises a disposition to throw off swarms, which, of course, will issue more or less frequently, more or less early, and in greater or less force, according to the temperature of the season, the fertility of the queen, the populousness of the stock, and the attention that has been paid to early feeding.

It is a prevalent opinion, that a swarm consists entirely of young bees; but this is an error: every swarm contains a mixture of young and old; the latter are distinguishable by being of a redder hue, and having ragged wings.

*In favourable seasons, a good stock will throw off three swarms, even a swarm of the current year will sometimes throw off another swarm; in this latter case, there is but a small collection of honey, compared with the great number of bees which have been called into existence. I have endeavoured to account for this in page 113. In the Monthly Magazine, for Sept. 1825, an instance is*

recorded of five swarms being thrown off and hived before the end of July from planting one single stock ; the season was favourable, and the situation, (High Armaside in Lorton), particularly so. They were not all thrown off from the first or parent stock, but from that and the earliest swarm. Bose, the French consul in Carolina, has stated that he had eleven swarms in one season from a single stock ; and that each of those swarms, during the same season, threw off the same number of secondary ones!!!! The space which usually intervenes between the first and second swarm is from seven to nine days ; between the second and third, the period is shorter ; and if there should be a fourth, it may depart the day after that which precedes it.

This succession of swarms must be owing to the great number of young queens that obtain their liberty. As they greatly weaken the parent stock, and are naturally weak themselves, the only resource under such circumstances is the union of two or more of the swarms into one family.

*March is the month in which the grand laying of the queen usually commences ; yet when January proves mild, the breeding will sometimes begin at the latter end of that month, and it is by no means an uncommon thing for the commencement to happen in February. The queen-bee may*

naturally be expected to breed earlier in the season than insects in general, from the circumstance of the working-bees storing up food for the young, which other insects, that breed later, do not; as also from her living in the midst of a society which preserves a summer heat during the coldest months of winter. A thermometer in a bee-hive has ranged as high as  $74^{\circ}$  Fahrenheit at Christmas; and Bonner says that he has often seen his hives with young brood in them in the midst of a severe frost. In the Transactions of the Society for the Encouragement of Arts, &c. Mr. HUBBARD has stated that vigorous well-stored hives breed even in the depth of winter. In this perhaps he was mistaken; the finding of eggs and maggots in the cells does not satisfy my mind, as they might have been laid late in the autumn, and have remained stationary till spring. Riem states, that in a bad season the eggs will remain in the cells many months without hatching. Mr. Hubbard was led to make the experiment of suffocating a strong stock in February, to ascertain the state of the brood combs; in which he says that he found an abundance of brood, in every state, from that of egg to the almost perfect fly; although the preceding January had been very cold, accompanied by frost and snow,—a circumstance which in some measure confirms my supposition, as to the suspended development of the brood. Mr. Hubbard

further adds, that on examining two weak hives, in March and April, he found not a single egg. From these very opposite states Dr. EVANS infers the great importance of leaving stocks strong in October, and feeding them in an ungenial autumn, conceiving that the bees apportion the numbers of their young to the means they possess of supporting them. That

“The prescient Female rears her tender brood  
In strict proportion to the hoarded food.”

This, however, does not correspond with what will be stated below ; from which it will appear, that the queen sometimes lays eggs, in reliance upon an approaching season, and does not let the number altogether depend upon the stock of provision in the hive. The commencement of the queen's breeding may generally be known, by the bees carrying in pellets of farina on their thighs. For want of a sufficient supply of this, as must happen in cold unkindly seasons, many of the nymphs are cast out, having died probably from actual starvation. Hence the necessity, as before stated, of having in the immediate neighbourhood of the hives such early blossoming trees and flowers as afford plenty of farina; and also late blossoming ones, that the bees may be enabled to lay in a store of it, ready for spring.

Swarming may take place at any time between the beginning of April and the latter end of Au-

gust. It seldom happens before ten in the morning, nor later than three in the afternoon, and never but in fine weather. If it be sultry, bees are apt to rise after a storm, being anxious to escape from the heat of the hive, rendered more intolerable by the confinement which the storm has occasioned. In the sixth volume of the *Philosophical Transactions*, an instance is recorded by RICHARD REED, Esq. of Lugwardine, of a swarm issuing on the 9th of March; as he supposed, in consequence of there being an insufficient supply of food for the whole family, a part were sent forth to seek their fortunes, lest the whole should perish. The day, he says, was fine, but does not mention the temperature. Probably this was a stock which had bred in the month of February, the swarm issuing from the usual cause, a disproportion between the size of the family and the size of the habitation.

If early swarming be desired, early breeding must be promoted, by feeding with sugared or honeyed ale in February and March, and by keeping the stock warm. And if the apiarian at any time wish to obtain a swarm, he has only to withhold from his bees that accommodation which storifying affords them.

The most advantageous time for a swarm to be thrown off is from the middle of May to the middle of June. This period comprehends the grand

harvest season of the honeyed race. After the scythe has cut down the flowers which adorn our meadows and yield the bees such a plentiful supply of honey and farina, there is a very manifest relaxation in their activity; their excursions are not only much less extensive, but less frequent, although the weather be in all respects propitious. Swarms that issue much earlier than the time I have specified, are apt to be small; and should bad weather succeed, feeding will be necessary, to prevent famine. Those that issue later, afford no better promise, either to themselves or to the parent hives; for though late swarms are usually large ones, they will scarcely have time to rear their brood, and to lay in a store of honey, &c. adequate to the support of the family during the ensuing winter and spring. Late swarming is not only hazardous to the bees thrown off, but is injurious to the parent stock, which suffers in proportion to the loss of labourers, that should contribute to the general store of food, and assist in rearing the brood, which is generally abundant, though the season be far advanced.

Hence it is the usual practice, early in the autumn, to suffocate both the swarm and the stock, in order to secure whatever wax and honey may have been collected up to that time. There is however another alternative, as will be seen under the head of *Uniting Swarms or Stocks*.

If several days of rainy weather should succeed a swarm's going off, the stores they carry with them from the parent hive may be exhausted and endanger a famine ; in such a case recourse must be had to feeding.

## CHAPTER XIV.

## COMPARATIVE ADVANTAGES OF STORIFYING AND SINGLE-HIVING.

FROM what has been said in the two last chapters, a comparative estimate may be made of the advantages which storifying possesses over single-hiving ; and they appear to be the following.

First, an œconomical division of labour, an advantage common to all bodies of artificers, whose works are conducted upon a large scale, and which causes a larger quantity of wax and honey to be collected in the season, than if the bees were to swarm, and to carry on their operations in separate families.

Secondly, the facility with which the bees may be deprived of a considerable portion of their honey, without destroying their lives, or communicating to the honey any unpleasant flavour, from the sulphurous gas.

Thirdly, the power which is afforded to the bees, of employing themselves usefully during wet weather, in the manner before stated.

Fourthly, the saving of that time which is unnecessarily spent in the construction of fresh combs, in the new habitation.

Fifthly, the saving of room ; for as every family

has more warehouse-room than its respective necessities require, the division into small families must multiply the proportion of this superfluous room.

Sixthly, the saving of the time usually lost in preparation for swarming, when the bees hang inactively in clusters, on the outsides of the hives, for many days, sometimes for weeks, particularly if the weather be unfavourable.

It seems right to remark in this place, that though this *clustering* or *hanging out* of the bees is generally regarded as one of the strongest symptoms of an approaching swarm, it is nevertheless a deceptive one. It does certainly indicate that there are bees sufficient to throw off a swarm, and is sometimes evidence of an anxiety to do so; but unless there be a queen ready to go off with them, however distress for room, the clustering will sometimes continue for a considerable time; in hot dry seasons it may last till the middle of August. This clustering, as before observed, is very prejudicial, as it causes the bees to be inactive in their principal harvest season, when every bee ought to be fully employed, and may induce a habit of inactivity for the future. Clustering likewise obstructs the operations of the bees that are active, by interrupting the thoroughfare to the hive. These disadvantages are admirably remedied by storifying, without which,

independently of the loss of time to the bees, a constant system of watchfulness must be kept up by the proprietor, during the whole period of the bees clustering out, otherwise a swarm may be lost.

Storifying, though generally, is not invariably successful in causing the clustered bees to re-enter the boxes: where it fails to do so, if a young queen were ready to assume the sovereignty of the colony, the clustered bees would swarm and seek a new habitation with the old one. M. Reaumur drowned several hives thus circumstanced, and examined all their inmates most minutely, but could never find more than a single queen, and this the old one; in none of these hives did he find royal larvæ.

KEYS says that he has *failed to make the clustered bees rejoin the family, if he has put the empty hive or box over the colony*; but that by *placing the box under it, the bees soon re-entered and worked vigorously*. I have myself, in several instances, noticed the reluctance of bees to ascend; this reluctance will however generally give way in a day or two, if no room be allowed them in any other direction. This is proved by the successful use of small glasses upon flat-topped hives or boxes, for obtaining fresh honey occasionally. THORLEY *constantly practised super-hiving*, and was very successful with it. So likewise is my

friend MR. WALOND, who finds it afford him a supply of purer honey than nadir-hiving; for as the queen is generally found more disposed to descend than to ascend, by placing the box over the stock it will seldom be stored with any other combs than those which contain honey. MR. GEORGE HUBBARD, however, of Bury St. Edmunds, in a paper contained in the Transactions of the Society of Arts, vol. ix. (for which they awarded him ten guineas), says that he has known instances in which the *bees have swarmed rather than submit to super-hiving.*

*Bees have been known to construct combs under the floors of the hives, when restricted for room within.* Here their natural activity surmounted the impediments thrown in their way, by the want of inclosed space. The storifying or colonizing plan has been much applauded for its saving the lives of the bees: though this preservation be well worthy of attention, yet it is an advantage very inferior to that which is derived from the economical division of labour, the consequent increase of wax and honey, and the facility afforded for extracting them. I trust that this remark will not expose me to the imputation of inhumanity, for I am fully sensible of the value of life to all creatures that exist, and have often felt strongly the force of Thomson's pathetic description of the sulphurous death of bees.

“ Ah ! see where robb’d and murder’d in that pit  
Lies the still heaving hive ! at evening snatch’d,  
Beneath the cloud of guilt-concealing night,  
And fix’d o’er sulphur.....

“ Sudden the dark oppressive steam ascends,  
And, us’d to milder scents, the tender race  
By thousands tumble from their honey’d dome,  
Convuls’d and agonizing in the dust.”

The bee is generally allowed to be a short-lived insect. (*Vide* Longevity of Bees.) Whatever advantage can be derived however, from preserving the lives of the bees, at the period of taking their honey, those, who keep them upon the storifying plan, will have the full benefit of it, and be spared that torture of feeling, which the sensitive always experience, when destroying life in any way.

“ True benevolence extends itself through the whole compass of existence, and sympathizes with the distress of every creature capable of sensation. Little minds may be apt to consider a compassion of this inferior kind, as an instance of weakness, but I consider it as affording undoubted evidence of a noble nature.”—*Melmoth*.

## CHAPTER XV.

## SYMPTOMS WHICH PRECEDE SWARMING.

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“ See where with hurry’d step, th’ impassion’d throng  
Pace o’er the hive, and seem with plaintive song  
T’ invite their loitering queen ; now range the floor,  
And hang in cluster’d columns from the door ;  
Or now in restless rings around they fly,  
Nor spoil they sip, nor load the hollow’d thigh :  
E’en the dull drone his wonted ease gives o’er,  
Flaps the unwieldy wing, and longs to soar.”

EVANS.

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NOTWITHSTANDING what I have said in the last chapter on the subject of clustering, it is too important a circumstance to be omitted in the following enumeration of the signs of swarming.

1. Clustering or hanging out, if taken singly, may be regarded as a fallacious symptom, but when conjoined with other indications, it may be considered as a sign of swarming, particularly if accompanied by the signs enumerated at the commencement of my motto.

2. The drones being visible in greater numbers than usual, and in great commotion, especially in the afternoon.

3. The inactivity of the working bees, who

neither gather honey nor farina, though the morning be sunny and the weather altogether inviting. Reaumur regarded this as the most indubitable sign of preparation for swarming.

4. A singular humming noise, for two or three nights previous, which has been variously described and accounted for. It cannot always be distinguished, unless the ear be placed near the mouth of the hive; the sounds, which are sharp and clear, seem to proceed from a single bee. Some suppose the noise to be made by the young queen, and to resemble *chip chip peep peep* or the *toot toot* of a child's penny trumpet, but not so loud; Mr. Hunter compares it to the lower *a* in the treble of the piano-forte. It is readily distinguishable by those who have been accustomed to hear it. DR. EVANS inquires, is it the sound emitted by perfect queens, on emerging from their cells, as described by M. Huber? The noise is sometimes in a shrill, at other times in a deeper key; this difference in the intensity of the tones may arise from the distance whence the sound proceeds, or may be intended to intimate to the bees the respective ripeness of their queens. BUTLER and WOOLRIDGE ascribe it to a parley between the old and young queens, the latter at the bottom of the hive requesting leave to emigrate, and the former answering in

her bass note from the top. WILDMAN supposes it to arise from a contest betwixt the queens, about sallying forth; and endeavours to account for its less frequency before first swarms, from the young chiefs being then in their embryo state. This however is mere hypothesis, and not at all consonant with later discoveries, particularly those of Huber and Dunbar. *Vide* pages 18 and 22.

5. Unusual silence in the hive, during which the separatists are supposed to be taking in a cargo of honey before their flight, as a provision against bad weather. Mr. Hunter opened the crops of some bees that remained in the parent hive and the crops of some emigrating bees, when he found the latter quite full, whilst the former contained but a small quantity.

*The above symptoms oftener precede second or third than first swarms, which latter sometimes issue forth without any previous notice.* KEYS speaks so emphatically upon this subject that I shall quote his words. "Although there are no signs that precede first swarms, those, before mentioned, convey to the apiator one certain meaning, and when heard he may be assured that the first or prime swarm has escaped, if that will comfort him."

The moment before their departure exhibits a

very lively agitation, which first affects the queen, and is then communicated to the workers, exciting such a tumult among them, that they abandon their labours, and rush in disorder to the outlets.

If a swarm quit the first place on which it clusters, it hovers in the air for some time, as if undetermined, and then flies off with great velocity.

We hear now and then of a swarm of bees being lost, of its having eluded the vigilance of the proprietor; I think that its loss is generally attributable to negligence. As a different opinion is prevalent, I shall state a few of the facts upon which that difference is founded.

HOMER and VIRGIL speak of bees in their wild state as fixing their habitations in the rocks and in hollow trees.

“As from some rocky cleft the shepherd sees,  
Clustering in heaps on heaps, the driving bees.”

POPE'S HOMER.

“And oft, ('tis said,) they delve beneath the earth,  
And nurse in gloomy caves their hidden birth,  
Amid the crumbling stone's dark concave dwell,  
Or hang in hollow trees their airy cell.”

SOTHEY'S GEORGICS.

Many instances are also recorded of domesticated bees seeking an asylum in some hollow part

of an old building or tree. DR. WARDER, MR. BUTLER, MR. KNIGHT, DR. EVANS, M. DUCHET, and other writers think that the bees about to swarm regularly send out scouts, to explore an eligible situation for their future residence; though Dr. Evans admits that this disposition to resume wild habits, like many of the instinctive faculties of the animal creation, has its intensity weakened by domestication. Dr. Warder asserts that the bees always send out providers, to select a suitable residence for them, several days before swarming, and considers that their clustering upon a bough, &c. soon after they issue forth, proceeds from their desire to be all congregated together prior to the last flight: this is likewise the opinion of Mr. Knight. If the place selected be a deserted hive, it is first cleared by the bees of all heterogeneous matters, the old combs alone being allowed to remain. An observance of this conduct probably led COLUMELLA to recommend the placing of empty hives, during the swarming season, in appropriate situations near an apiary. KEYS gives a similar recommendation. REAUMUR on the other hand ridicules the idea of "spies and quartermasters," as ingenious fable. What I have stated in Chapter xvii. p. 148. confirms Reaumur's opinion: he is also supported in it by BUFFON, BONNET, and HUBER: the former says,

that the swarming bees form a cloud round their queen, and set off without seeming to know the place of their destination;—"the world before them, where to choose their place of rest." I will however detail a few cases that support the theory of "spies and quartermasters." In the Philosophical Transactions for 1807, MR. KNIGHT, writing to Sir Joseph Banks, relates several instances of the kind. On one occasion he observed from twenty to thirty bees paying daily visits to some decayed trees, about a mile distant from his garden; the bees appeared to be busily employed in examining the hollow parts, and particularly the dead knots around them, as if apprehensive of the knots admitting moisture. In about fourteen days, these seeming surveyors were followed by a large swarm from his apiary, which was watched the whole way, till it alighted in one of these cavities. It was observed to journey nearly in a direct line from the apiary to the tree. On several similar occasions the bees selected that cavity which Mr. Knight thought best adapted to their use. He has also noticed that, a stock being nearly ready to swarm, one of these hollow trees was daily occupied by a small number of bees; but the swarm from that stock, being lodged in another *hive*, the tree was wholly deserted. This preference of a *hive*, when offered

them, to a place chosen by themselves, Mr. Knight ascribes to a habit acquired by domestication, which generating a dependence upon man for providing them a dwelling, descends hereditarily from the parents to their offspring. Another instance is related by DR. EVANS: he suffered a hive, whose tenants had died in the winter, to remain upon the stand till spring: he then observed several bees paying it daily visits, and busily employed within, but leaving it at the close of evening. These soon appeared, like Dr. Warder's providers, to be the harbingers of a swarm; for, early in June, an immense body of these insects were seen rapidly approaching, and then surrounding the hive: they took possession as quickly as its narrow entrance and crowded combs would permit. The same result was noticed after the mild winter of 1806-7, which untenanted one of his hives by famine: he was present when the swarm issued (from another hive in his garden) to take possession of the empty one, which, on his endeavouring to raise it, to give facility to their entrance, he found already cemented to the floor. The Doctor also relates a case in which a swarm of bees "made its way either over the tops of some very high houses, or through several winding streets, to an old house in the centre of Shrewsbury, and

passing through an aperture in the wood-work to a room on the first floor, were there hived by the family. MR. BUTLER in his *Feminine Monarchie* mentions the case of a poor woman whose hive being depopulated by famine was allowed to remain out of doors till the ensuing summer, when a swarm took possession of it, from which she afterwards stored her garden. Other instances of a similar kind have been related; but in most of them it is not easy to ascertain how far the proprietors of the hives, from which the swarms went forth, had been improvident. The cases related by Mr. Knight are the most remarkable; but with respect to these, further information would be desirable. Was there any inducement beyond a snug housing in the cavities of the trees, to tempt the bees to wander so far from their native spot? such as favourite pasturage, or neighbouring trees that were wont to supply honey-dew? or were there in either of the hollow trees, thus occupied, any old combs which had been left there by another family? Lastly, were the emigrating bees exposed to any annoyance in their old habitation, either from neighbours of their own species or the attacks of other animals? or were they deprived of any sheltering protection to which they had been accustomed, by the removal of buildings, the

cutting down of trees or otherwise? BONNER, who agrees in opinion with Mr. Knight, that bees often go in quest of a suitable habitation, before they swarm, has observed that he knew for certain that a swarm would not fly a mile to an empty hive, "whereas they will fly," says he, "four miles to take possession of an old one with combs in it."

## CHAPTER XVI.

## HIVING OF SWARMS.

THE hiving of bees is a proceeding so well known that it seems unnecessary to offer any observations on the particular method of effecting it.

In every apiary there should be a stock of hives, boxes, &c. always ready before-hand, either for storifying or for single hiving; a neglect of this precaution will often be productive of great inconvenience and confusion.

It is always desirable to *have swarms put into new hives*, as old ones often contain the larvæ of moths and other embryo insects, which may prove injurious to the bees. If straw be the material with which they are made, every rough straw should be removed from the interior, otherwise the bees will lose that time in rendering it smooth, which they could employ to greater advantage in gathering honey and constructing combs. For a similar reason, if boxes be preferred, these should be made air-tight with putty or other cement, that the bees may not consume their time in filling the crevices with propolis. If on any occasion the apiarian be induced to have recourse to *an old hive*, for receiving a swarm, it *should, before being used, be dipped into boiling water*, to destroy the

eggs of moths and other insects, after which it should be made perfectly dry.

In the common straw-hive, two new sticks placed across each other, at the second round of straw from the bottom, will be useful to support the weight of combs: the bees require no aid at the top, to which they will themselves securely attach the combs, as may be seen in hollow trees where bees have taken up their abode.

*Dressing the insides of the hives* is of doubtful advantage. Some people rub the interior of the hive with balm, bean-tops, fennel, &c. or smear it over with cream and honey. Wildman strongly reprobates this practice, as it gives the bees the trouble of making the hive clean again. If any thing be used, in compliance with custom, sugared or honeyed ale is the most alluring. KEYS says that a hive, containing old combs and dressed with sugared ale, will often decoy a swarm to settle in it. HUISH recommends sprinkling the interior of the hives with human urine; which he regards as a specific, on account of “its *abounding* with *sugar* and *salt*, two substances of which bees are particularly fond:” if such were the fact, it would I think, be more cleanly, and therefore a preferable plan, to mingle those favourite articles with a little ale or water for this purpose. Huish himself recommends smearing the interior of the hive with honey, when a swarm of bees settle in

a situation, from which it cannot be dislodged and made to enter the hive, by shaking or other forcible means. If urine be attractive to bees, its attraction must proceed from other qualities than those which he has mentioned ; it does certainly contain a *very small portion of salt*, but I know of no analysis of healthy human urine, which admits *sugar* to be a constituent part of it.

A tinkling noise is generally, though I believe erroneously, considered to be useful in inducing bees to settle. KEYS recommends the use of a watchman's rattle, but not till the queen has come forth, for fear of alarming her too soon, nor after the bees have begun to cluster.

KEYS advises also the throwing of sand or water among the bees, to make them cluster ; likewise the making of some *very great noise*, such as firing a gun ; some have supposed the bees to mistake a loud noise, for thunder foreboding a storm ; but this, instead of causing them to settle, would rather cause their return to the parent stock. DR. EVANS suggests the probability of noises being first used, as signals to the neighbours that a swarm was up, and being afterwards continued by habit only. The throwing up of handfuls of dust or sand, is said to make bees descend, when they soar very high ; these missiles being mistaken for rain.

*Bees, when swarming, are generally peaceable, and if treated gently, may be hived without*

danger or difficulty. *A remarkable instance of their inoffensiveness at this time* is related by MR. THORLEY. Wanting to dislodge a swarm from the branches of a codlin-tree, he placed the hive in the hands of his maid-servant, who being a novice, covered her head and shoulders with a cloth, to guard her face; on shaking the tree, most of the bees alighted upon the cloth, and quickly crept under it, covering the girl's breast and neck up to her very chin. Mr. T. impressed her with the importance of neither flinching from nor buffeting the bees, and began immediately to search for the queen; which on finding, he gently seized and removed, but without effecting a dislodgement of the swarm: thus disappointed, he suspected that there was a second queen; which actually proved to be the case: on securing, and placing her also in the hive, with a portion of the bees, the rest followed in multitudes, till in two or three minutes not one bee remained upon the girl, who was thus released from her state of apprehension and alarm, without feeling the point of a single sting. All persons similarly situated may not be so fortunate, as, notwithstanding the greatest precaution, bees may be provoked to draw their swords. DR. EVANS relates a case of this kind; a swarm having settled on the branch of a larch-tree, and its long tufts of narrow leaves flapping the bees as the bough was shaken, the

woman who hived them, received above thirty stings. If the weather be windy, at the time of swarming, they are often irritable, and apt to sting; though clustered, they will frequently return home: this last occurrence is generally caused by the absence of a queen; but it may also be produced by a sudden shower, or by the transit of a dark cloud.

A queen has sometimes a defect in her wings, or is disabled by some accident; either of these misfortunes may cause the return of a swarm, or produce symptoms of discontent after hiving.

As many persons doubt *the queen's importance* to the harmonious union of a swarm, I shall give an instance or two, to show how essentially necessary her presence is to produce this effect. DR. WARDER being desirous of ascertaining the extent of the bees' "loyalty to their sovereign, ran the hazard of destroying a swarm, for this purpose." Having shaken on the grass, all the bees from a hive which they had only tenanted the day before, he searched for the queen, by stirring amongst them with a stick. Having found and placed her, with a few attendants, in a box, she was taken into his parlour; where the box being opened, she and her attendants immediately flew to the window, when he clipped off one of her wings, returned her to the box, and confined her there for above an hour. In less than a quarter of an hour, the

swarm ascertained the loss of their queen, and instead of clustering together in one social mass, they diffused themselves over a space of several feet, were much agitated, and uttered a piteous sound. An hour afterwards they all took flight, and settled upon the hedge where they had first alighted, after leaving the parent stock ; but instead of hanging together, like a bunch of grapes, as when the queen was with them, and as swarms usually hang, they extended themselves thirty feet along the hedge, in small bunches, of forty, fifty, or more. The queen was now presented to them, when they all quickly gathered round her, with a joyful hum, and formed one harmonious cluster. At night the Doctor hived them again, and on the following morning repeated his experiment, to see whether the bees would rise ; the queen being in a mutilated state, and unable to accompany them, they surrounded her for several hours, apparently willing to die with her rather than desert her in distress. The queen was a second time removed, when they spread themselves out again, as though searching for her : her repeated restoration to them, at different parts of their circle, produced one uniform result, "and these poor loyal and loving creatures, always marched and counter-marched every way as the queen was laid." The Doctor persevered in these experiments, till after five days and nights of fast-

ing, they all died of famine, except the queen, who lived a few hours longer and then died. *The attachment of the queen to the working bees*, appeared to be equally as strong as their attachment to her; though offered honey on several occasions, during the periods of her separation from them, she constantly refused it, "disdaining a life that was no life to her, without the company of those which she could not have."

My next instance is contained in the *Transactions of the Society of Arts*, &c. for 1790, in a paper written by MR. SIMON MANLEY, of Topsham in Devonshire, for which the Society awarded him five guineas. "I have before now," says he, "taken the queen bee, while in the act of swarming, put her into a clean bottle, and kept her from the swarm a full hour. I have then shown her to several gentlemen, the swarm continuing to hover, without settling, the whole time. I brought her home, and laid her on the floor of a kitchen window. Being moist with her own breath in the bottle, when I took her out she licked herself clean, and being quite recovered, was carried out and placed upon the hive she swarmed from. About a handful of her subjects soon found her out, and seemed much rejoiced at finding her. From thence she rose up, and pitched upon a currant bush, and the remainder of the swarm came to her, and settled at once."

SWAMMERDAM tried the experiment of fastening the queen by one of her legs to the end of a pole, by which he induced the bees to follow him wherever he chose. Reaumur relates a somewhat similar instance of a bee-man mentioned by FATHER LABBAT in his Travels, who had the address to conceal the source of his dexterity. WILDMAN'S expertness in this way was celebrated far and near. *Vide* chapter on Uniting Swarms.

In confirmation of the evidence I have already given, of the queen's importance to the well-being of the community, I will advert to some experiments of HUBER. He removed a queen from one of his hives; the bees were not immediately aware of it, but continued their labours, watched over the young, and performed the whole of their ordinary occupations. In a few hours afterwards, agitation commenced, and all appeared to be a scene of tumult; a singular humming noise was heard, the bees deserted their young and rushed over the surface of the combs, with delirious impetuosity. On replacing the queen, tranquillity was instantly restored; and from what will be said presently, it appeared that they knew her individual person. Huber varied this experiment with other hives, in different ways; instead of restoring their own queen, he tried to substitute *a stranger queen*; the manner of her reception depended upon the period at which she was in-

roduced. If twenty-four hours had elapsed after the removal of the queen, the stranger was well received, and at once admitted to the sovereignty of the hive. If not more than eighteen hours had elapsed, she was at first treated as a prisoner, but after a time permitted to reign. If the stranger was introduced within twelve hours, she was immediately surrounded by an impenetrable cluster of bees, and commonly died either from hunger or privation of air. It appeared therefore, in the course of these experiments, that from twenty-four to thirty hours were required, for a colony to forget its sovereign, and that if, before the lapse of that period, no substitute was presented, they set about constructing royal cells, as stated in page 22; and moreover, that if, during the time they were so occupied, a princess was brought to them, the fabrication of royal cells was instantly abandoned, and the larvæ selected to occupy them were destroyed. On the admission of a welcome stranger queen, more regard is perhaps shown to her at first, than to a restored natural queen,—at least there are more conspicuous demonstrations of it: the nearest workers touch her with their antennæ, and, passing their proboscis over every part of her body, give her honey. In the cases above related, the bees all vibrated their wings at once, as if experiencing some agreeable sensations, and ranged themselves

in a circle round her. Others, in succession, broke through this circle, and having repeated the same process, of touching her with their antennæ, giving her honey, &c. formed themselves in a circle behind the others, vibrating their wings and keeping up a pleasurable hum. These demonstrations were continued for a quarter of an hour, when the queen beginning to move towards one part of the circle, an opening was made through which she passed, followed and surrounded by her customary guard. Such is the substance of Huber's account: it does not entirely correspond with what has been stated by Dunbar. *Vide* chapter on Bee-boxes.

The loyal *attachment of bees to their queen* extends even beyond this: HUBER states that he has seen the workers, "after her death, treat her body as they treated herself when alive, and long prefer this inanimate body to the most fertile queens he had offered them." And DR. EVANS relates a case, in which a queen was observed to lie on some honey-comb in a thinly peopled hive, apparently dying, and surrounded by six bees, with their faces turned towards her, quivering their wings, and most of them with their stings pointed, as if to keep off any assailant. On presenting them honey, though it was eagerly devoured by the other bees, the guards were so completely absorbed in the care of their queen, as

entirely to disregard it. The following day, though dead, she was still guarded; and though the bees were still constantly supplied with honey, their numbers were gradually diminished by death, till, at the end of three or four days, not a bee remained alive.

WILDMAN says that if the queen of a swarm be lost, though it happen several weeks after leaving the mother hive, the bees will return to it, carrying their honey with them. This, if true, must occur where no grub can be converted into a queen. Both REAUMUR and WILDMAN tried the experiment of introducing a royal larva into a queenless stock, when the bees immediately set to work again, on the inspiration of *hope* alone.

Should symptoms of discontent be observed after hiving, the queen will probably be discovered on the ground, or somewhere apart; surrounded by a small cluster of attendants, whom nothing but violence can separate from her. If she be taken up either singly or with the cluster, and placed near the entrance of the hive containing the swarm, all will be harmony.

*Sometimes a swarm divides into two portions, which settle apart from each other and have each a distinct leader. The conduct of the apiarian must be governed by the size of the two divisions, and the season at which they emerge; unless both be large and the swarming early, they had better*

be hived in separate boxes, and joined together, in the manner recommended in Chap. XIX.

COLUMELLA was the first who proposed union by killing the supernumerary queen.

The branch on which the swarm settled is sometimes rubbed with wormwood, or smoked with disagreeable fumes, to drive away all remaining loiterers.

In every operation, it is desirable to avoid crushing a single bee, as, in case of discovery, the rest are excited to anger. See chapter on the *Senses of Bees*.

Immediately on the bees taking to the hive, it should be placed upon a table, on a proper floor board, and be covered with boughs or a cloth; and the hive should be near the parent stock, to catch stragglers, on their return home. At night it should be removed to its permanent station.

## CHAPTER XVII.

ON REMOVING BEES FROM COMMON  
STRAW-HIVES TO STORIFYING HIVES  
OR BOXES.

MANY plans have been suggested for transferring bees from hives to boxes ; but excepting in the case of a recent swarm, I would not recommend any, but an experienced apiarian, to attempt an immediate transfer.

In the case of a recent swarm, the method of effecting the object is simple and easy ; for if, when the bees have retired for the night, the hive be placed upon a middle board, with a divider underneath it, and the whole be inverted upon a small tub or a peck measure, and an empty box be raised upon the divider, this latter being withdrawn, and every opening besides what is necessary for admitting air being well secured, the bees will all probably have ascended into the box by morning, when with the assistance of the dividers they may be placed in the bee-house or any where else that the proprietor chooses, just as if they had been originally hived in the box. If the ascent have not taken place in the morning, it may be effected by drumming smartly with two sticks, upon the sides of the hive : in this way, the ascent

may be known by the loud humming noise by which it will be accompanied.

I have said that the above plan is only to be recommended in cases of recent swarming : by this I mean, in swarms of the day on which it is attempted, and before any works are constructed in the hives, to such an extent as to make the bees tenacious of their new habitation ; for wherever they form a settlement, though even for the short time that they occupy a bush or tree before hiving, there are always to be seen the rudiments of one or more combs, showing, that they always intend, (so far as one can give bees credit for intention,) to take up their abode, permanently, upon the very spot on which they first cluster round their Royal Leader.

If however, from want of forethought or from any other causes, a swarm have been allowed, for a longer period, to occupy a hive from which it is desirable to dislodge it, in that case I would recommend the apiarian, towards night, to place the hive upon a middle board with a divider underneath it, to lute the junction with clay, so as to prevent the bees from escaping, and to invert the whole upon a stool that has had an opening made in it of sufficient size to allow the hive to sink about half way through it. Then, if he raise a couple of empty boxes upon the divider, in the manner already directed for super-hiving, and

having adjusted the whole, withdraw the divider, the bees will soon desist from carrying on their works in the hive, and commence new ones in the upper box ; the hive at the period of deprivation may be separated from the boxes in the usual way.

The middle board that is used on this occasion, provided the colony be designed to stand out of doors, must have a resting board attached to the edge of it, for the bees to alight upon. And as it is intended to serve as a substitute for a floor board, it must be made to correspond with the floor boards in its construction, so far as respects its giving liberty for the bees to have ingress and egress, and its affording a power to shut them in.

If it should be thought more convenient, an entrance could readily be formed, by cutting a piece out of the lower edge of the box, in which also a groove might be cut for a slide to run in.

## CHAPTER XVIII.

SUPER- AND NADIR-HIVING BY MEANS OF  
DIVIDERS.

WHEN one hive or box is to be raised upon another in a bee-house, the operation may be performed at any time ; the best time is about ten or eleven o'clock in the morning, when a great portion of the bees are ranging the fields. If the bees be kept in an out-door hive, the operation will be best performed in an evening or early in a morning, when, all the bees being at home, they may be shut in and thereby prevented from annoying the operator.

If *super-hiving* be the object of the apiarian, he must first withdraw the four screws out of the top board of his stock hive or box, so as to enable him to push one of his dividers from front to back, between that board and the box which it covers ; he may then safely take off the top, and screw it upon an empty box. (He would of course be enabled to accomplish the business with more promptitude, if he have a supernumerary top already screwed down.) Having put the fresh box upon a middle board, the whole is to be carefully placed upon the divider, that covers the stock : when accurately adjusted to each other, if an

assistant hold firmly in their places the two boxes, or the inferior box and the middle board, the divider may be withdrawn, and thus a communication between the two boxes will immediately be effected, without the escape, and perhaps without the destruction, of a single bee.

When I have had no assistant near me, upon whose steadiness I could rely, at the time of withdrawing the divider, I have fixed a piece of double quarter with one of its ends against the inferior box, and the other against the wall opposite to it, and have thus effectually prevented the box from moving, whilst with one hand I held firmly the middle board, and drew out the divider with the other. My readers are to suppose me operating in a bee-house, for in an out-door apiary an assistant will always be required, whenever any important operation is to be performed.

*Nadir-hiving* is accomplished by introducing both dividers between the floor board and the box or hive which it supports, the first with its turned edge downwards, and the other upon it with its turned edge upwards. The box or boxes are then to be removed on one side or upon a table, together with the upper plate or divider, which will form a temporary floor to the box, while the lower plate covers the wooden floor and those few bees that may be lodged upon it.

In removing the box or boxes for nadir-hiving,

some caution is requisite, to prevent the escape of the bees. The safest plan is gradually to draw forward the boxes with their temporary floor, till they hang nearly half over the wooden floor, and then, by spreading out the fingers and applying them under each side of the divider, the whole may be lifted up and moved wherever it be most convenient till raised upon the nadir. When the box has been drawn half off, a weight should be placed upon the covering divider, to prevent it from tilting up.

The removal being accomplished, an empty box should be quickly placed upon the divider which covers the floor, and upon the box a middle board; the adjustment being complete, the dividers are to be withdrawn separately, and with the same precautions as in super-hiving.

If the apiarian wish to practise *centre-hiving* *i. e.* to introduce an empty box between a superior and an inferior one, he can easily apply the preceding directions to that particular case.

## CHAPTER XIX.

## UNITING SWARMS OR STOCKS.

THE union of swarms with their stocks, and of swarms or stocks with each other, in case of their being or becoming weak, has been attempted in various ways, and with various success, depending perhaps, in some degree, upon the skill and adroitness of the operator. Upon the storifying plan this operation will rarely be necessary, excepting in the case of weak stocks, as it is not a very common occurrence for storified bees to swarm, and when they do so, they generally throw off strong swarms. Still the object may occasionally be desirable, and it is worthy of attention, for *the tenants of well filled hives are always the most active.*

The three usual methods by which union has been attempted, and indeed their advocates say, accomplished, are *fuming them, immersing them in water, and aspersing them with sugared or honeyed ale.* To these I may add a fourth, namely *operating upon their fears*, by confining them for a time, and then alarming them by drumming smartly upon the outside of their domicile. It was operating on their fears that enabled Wildman to perform such extraordinary feats with bees.

When under a strong impression of fear, says he, they are rendered subservient to our wills, to such a degree as to remain long attached to any place they afterwards settle upon, and will become so mild and tractable, as to bear any handling which does not hurt them, without the least show of resentment. "Long experience has taught me, that as soon as I turn up a hive, and give some taps on the sides and bottom, the queen immediately appears." "Being accustomed to see her, I readily perceive her at the first glance; and long practice has enabled me to seize her instantly, with a tenderness that does not in the least endanger her person." "Being possessed of her, I can, without exciting any resentment, slip her into my other hand, and returning the hive to its place, hold her, till the bees missing her, are all on the wing, and in the utmost confusion." When in this state, he could make them alight wherever he pleased; for on whatever spot he placed the queen, the moment a few of them discovered her, the information was rapidly communicated to the rest, who in a few minutes were all collected round her. In this way he would sometimes cause them to settle on his head, or to hang clustered from his chin, in which state they somewhat resembled a beard. Again he would transfer them to his hand, or to any other part of his body, or if more agreeable to the spectators before whom he ex-

hibited, he would cause them to settle upon a table, window, &c. Prior to making his secret generally known, he deceived his spectators by using words of command ; but the only magic that he employed was the summoning into activity for his purpose the strong attachment of the bees to their queen.

“ Such was the spell, which round a Wildman’s arm  
Twin’d in dark wreaths the fascinated swarm ;  
Bright o’er his breast the glittering legions led,  
Or with a living garland bound his head.  
His dextrous hand, with firm yet hurtless hold,  
Could seize the chief, known by her scales of gold,  
Prune, ’mid the wondering train, her filmy wing,  
Or, o’er her folds, the silken fetter fling.”      EVANS.

Cautioning his readers as to the hazard of attempting, what he himself accomplished only by long experience and great dexterity, Wildman concludes his account with a parody of the reply of C. Furius Cresinus, a liberated Roman slave, who, being accused of witchcraft in consequence of his raising more abundant crops than his neighbours, and therefore cited before a Roman tribunal, produced his strong implements of husbandry, his well-fed oxen, and a hale young woman his daughter ; and pointing to them, said, “ *These, Romans ! are my instruments of witchcraft ; but I cannot show you my toil, my sweats, and anxious cares.* ” “ So,” says Wildman, “ may I say, *These, Britons !*

*are my instruments of witchcraft ; but I cannot show you my hours of attention to this subject, my anxiety and care for these useful insects ; nor can I communicate to you my experience, acquired during a course of years."*

*The neatest and most scientific mode with which I am acquainted of uniting weak families together in harmony was invented by my friend THE REV. RICHARD WALOND, whom I had occasion to mention in a former chapter, and whose experience in the management of bees, for nearly half a century, entitle his opinions concerning them to great respect. His theory and practice upon this subject are as follow. Bees, says he, emit a peculiar odour, and it is by no means improbable that every family of bees emits an odour peculiar to itself : if so, as their vision seems to be imperfect, and their smell acute, it may be by this distinctive and peculiar odour that they are enabled to discriminate betwixt the individuals of their own family and those of a stranger hive. Upon this supposition, if the odours of two separate stocks or swarms can be so blended as to make them completely merge into each other, there will then probably be no difficulty in effecting the union of any two families that it may be desirable to unite. To accomplish this end therefore, Mr. Walond had recourse to a very ingenious contrivance : he*

procured a plate of tin, the size of a divider, and thickly perforated with holes, about the size of those in a coarse nutmeg-grater. Having confined in their respective hives or boxes, the two families to be united, and placed them over each other, with only a divider between them ; he introduced his perforated tin plate upon the divider, which was then withdrawn. Immediately the bees began to cluster with hostile intentions, one family clinging to the upper, the other to the under side of the perforated plate ; when after remaining in this state for about twenty-four hours, they had so far communicated to each other their respective effluvia, and so completely commixed were the odours in both hives, that on withdrawing the perforated plate, the bees mingled together as one family, no disturbance being excited, but such as arose from the presence of two queens, the custom being always, in such case, to dethrone one of them. According to Huber this is effected by single combat between the queens : which subject will be adverted to in a future chapter. KEYS has observed that *these incorporations seldom turn to account unless they be effected in summer* ; and when it is considered that the principal gathering months are May and June, (excepting in those neighbourhoods that abound in lime, sycamore, and other trees that are apt to be affected with honey-dew,)

we cannot, of course, expect them to be very successful. I have entered fully into this subject, when speaking of early and late swarms, page 115.

To obviate the consequences there apprehended, some apiarians have had recourse to the practice of removing their bees to fresh pasture ; to districts where buckwheat is cultivated, or to the neighbourhood of heaths, or to any other place where such late blossoming flowers abound as afford honey. Mr. ISAAC assures us that he once had a poor swarm of a month's standing, which only weighed five pounds four ounces, and that on the 30th of July he had it removed to *Dartmoor Heath*, from whence it was brought home, two months afterwards, increased in weight twenty-four pounds and a half. He moreover states that the increase of others, that were sent there, was nearly proportional, and is of opinion that the whole addition was made during the month of August.

In LOWER EGYPT, where the flower harvest is not so early as in the upper districts of that country, this practice of *transportation* is carried on to a considerable extent. The hives after being collected together from the different villages, and conveyed up the Nile marked and numbered by the individuals to whom they belong, are heaped pyramiddally upon the boats prepared to receive them, which floating gradually down the river and

stopping at certain stages of their passage, remain there a longer or shorter time, according to the produce which is afforded by the surrounding country. "After travelling three months in this manner, the bees, having culled the perfumes of the orange flowers of the Said, the essence of roses\* of the Faicum, the treasures of the Arabian jessamine, and a variety of flowers, are brought back to the places from which they had been carried. This industry procures, for the Egyptians, delicious honey, and abundance of bees-wax. The proprietors, in return, pay the boatmen a recompence proportioned to the number of hives which have been thus carried about from one extremity of Egypt to the other." LATREILLE states that between Cairo and Damietta a convoy of 4000 hives were seen upon the Nile by NIEBUHR, on their transit from the upper to the lower districts of that country. Floating bee-hives were formerly common also in FRANCE. One barge was capable of containing from 60 to 100 hives, which, floating gently down their rivers, enabled the bees to gather the honey which is afforded by the flowers on their banks. REAUMUR likewise states it to have been the practice in some districts to transport them with similar views, by land, in vehicles

\* Whatever inducement the bees of Egypt may have to ply the roses of that country, with us they pay very little attention to those beautiful flowers.

contrived for the purpose. In SAVOY, PIEDMONT, and other parts of ITALY, the practice is also common. It is indeed of very ancient origin. Columella speaks of it as a very general custom among the Greeks, who used annually to send their beehives from Achaia into Attica.

These, however, are advantages which very few situations can afford; probably but few of my readers may reside in the neighbourhood of heaths, and still fewer may be disposed to incur the trouble and expense of removal. If therefore incorporation be desirable in any particular case, I can only recommend that attention be paid to feeding the bees with sugared ale; by the assistance of which, indeed, I should not be afraid of carrying, even a weak stock, very safely through the winter and early spring. "Give your bees," says Mr. Isaac, "two harvests in one summer" (alluding to the practice of transportation), "and you may make almost any swarm rich enough to live through the following winter." This second harvest may be very efficiently supplied by an attention to feeding, during mild weather in winter, and particularly in the early spring,—for the management of which, see Chap. XXIII. on Feeding.

## CHAPTER XX.

## PROPER PERIODS OF DEPRIVATION.

It should be an invariable rule with the apiarian, never to remove an upper hive or box, till an under one be quite full; and even then, it should be ascertained that the contents of the inferior one, (if taken at Michaelmas,) be not less than 18 pounds. If it do not contain so much, a sufficient quantity should be returned in the box that has been removed, otherwise recourse must be had to feeding. MR. ISAAC says that he has carried a colony that had no honey at Michaelmas, safely through the winter and spring, with only eight pounds of honey. Huber succeeded with less; but it appears that his observations were made upon weak stocks that were not altogether destitute.

A variety of experiments were made by MR. JOHN HUNTER and MR. KEYS, to ascertain *the quantity consumed during the respective months of winter and spring*, and they all led to one conclusion, namely, that it *amounted upon an average to eight pounds*, taking the season through, from the beginning of October to the end of May, when the spring proves ungenial. *During the first six months the consumption was not more*

than five pounds upon an average, and the colder the weather the smaller was the consumption. *Vide* 2nd page of Chap. XXIV.

*As a general rule,—no honey should be taken from a colony the first year of its being planted, though there may be an extraordinary season now and then, which may justify a departure from this rule; but neither in such an uncommon year, nor even in the second year, should the whole of the combs in any box be taken, (unless it be clearly ascertained that the centre combs contain no brood,) but only the external ones, which should be examined carefully one by one, and the brood combs, if any, be returned in the box to the stock. The apiarian, as HUBER observes, if he wish to obtain a considerable quantity of honey, should endeavour to secure his object rather by the number of his colonies, than by plundering a few of a great proportion of their treasures. A moderate participation is the most infallible means of preserving the stock.*

..... Should "Summer signs auspicious ride,  
And tubes unfailing pour the balmy tide,  
A full rich harvest, Bee-herds, may ye claim  
From the blithe tenants of your crystal'd frame.  
But long ere Virgo weaves the robe of sleet,  
Or binds the hoar-frost sandals round her feet,  
Close seal'd and sacred, leave your toil-worn hosts,  
The last kind dole their waning season boasts,

Lest coop'd within their walls, the truants prey  
On hoards reserv'd to cheer stern Winter's day."

EVANS.

MR. HUBBARD says that he has found *colonized bees frequently fail, in consequence of their having been robbed of too much honey*; it prevents early breeding. WILDMAN *particularly recommends cautious deprivation after July*, to avoid the attention which might be required in feeding, if the autumn should be unfavourable.

So much for the first and second years.—On the third, if the summer of that year as well as the summer preceding have been favourable for honey-gathering, the superior box will probably contain no brood, and may then be taken all at once.

The proceedings of the fourth and fifth years may fall under the practice of the second, but will probably allow of an earlier deprivation; some side combs may perhaps be taken away in July, and in October either the nadir or the centre box be removed entirely, and those above (if more than one) be brought down, and remain so till April; when the nadir may be introduced again.

*No hive or box should have its breeding combs left more than five years*; and in general, after the first year, the lower boxes will be found to be principally occupied for this purpose.

By this practice for four years out of every

five, whatever combs are removed will be new ones, which, on account of the purity both of the wax and the honey, are greatly preferable to old ones.

VIRGIL, probably copying his predecessor ARISTOTLE, describes *two harvests of honey every year*, namely, in the spring and in the autumn.

“The golden harvest twice each year o’erflows,  
Thou, twice each year, the plenteous cells unclose,  
Soon as fair Pleïas, bright’ning into day,  
Scorns with indignant foot the wat’ry way,  
Or, when descending down th’ aërial steep,  
She pours her pale ray on the wintry deep.”

SOTHEY’S GEORGICS.

“VARRO mentions *three harvests*; namely, at the rising of the Pleiads, about the twenty-second of April; the latter end of summer, and when the same stars set about the end of October: COLUMELLA recommends them to take place about the twenty-fifth of April and the twenty-ninth of June; PLINY in May and July; and PALLADIUS in June only.”—EVANS.

*Should such an accident occur as the destruction of a queen*, by the introduction of a divider (and she might be so unfortunately situated as to fall a sacrifice to it), *the stock will appear very much distressed* and very restless all day, particularly if there be no Royal Embryo or no very young larva; for in either of these cases they will soon

become reconciled. But if neither of them be present, and the bees be left to themselves, they will lose their wonted activity, gradually dwindle in number and pine away: or they will transfer their allegiance to another sovereign; and in that case, convey all the treasured sweets of their own hive, to that of the family they join. *The only remedy for such a misfortune* is to unite the bees to another stock, in the manner already directed, or to procure a supernumerary queen from another family. The latter, however, is an operation which few will have courage to attempt.

## CHAPTER XXI.

## TAKING HONEY BY MEANS OF DIVIDERS.

AFTER having noted the utility of Dividers, in adding fresh *empty* boxes, the reader will readily perceive their importance in the removal of *full* ones, when the period arrives for depriving a colony of a portion of its honey. In this case, the two dividers must be introduced between the middle board of the box to be removed and the box below it, precisely as in nadir living. In the act of deprivation a little more force will be required to push in, as well as to withdraw the divider, as it will generally have to pass through a portion of honey-comb. The above directions apply to the removal of an upper box, which will in general be the first for which they will be required. When any other is to be taken away, the plan of proceeding must be varied, but it would be tedious to give directions for every case; an intelligent operator by an attention to the instructions already given, and his own reflection, will be able to adapt his mode of proceeding to the particular exigency. Only one divider should be introduced till the situation of the queen be ascertained: if she be in the box intended for removal, the divider must be with-

drawn, and the experiment tried again in a week or two. If in an hour after the introduction of the divider, the bees in the box intended to be taken should exhibit symptoms of inquietude, it may be assumed that the queen is not within that box, the disturbance being caused by the anxiety of the bees to have access to her; whereas if she *be* in the box, the bees in company with her will be tranquil, and the excluded portion of the family will be in a state of commotion. Having, we will suppose, ascertained that the queen is in the desired place, the second divider should be introduced as before directed, when the box, with one of the dividers underneath it, must be removed. The apiarian, when performing this operation for the first time, may find it convenient to raise a stage of empty bee-boxes or other convenient articles, on one side or at the back of the box to be removed, and upon a level with the bottom of its middle board; he can then, after having introduced the dividers, very easily slide the full box, with its middle board and divider, over his temporary stage. (This mode of proceeding may likewise be found applicable on other occasions.) The operation having proceeded thus far, the box is ready for being applied over the hole of delivery, where a floor board should be placed with its sliding shutter open, and with an uncovered empty box

upon it. (If the full box were itself placed upon the floor board, stranger bees might smell the honey and become very troublesome intruders :—this is the reason why an empty box is interposed betwixt the full one and the floor board.) The full box and middle board, with the divider underneath them, being raised upon the empty box and the divider withdrawn, a portion of the bees will immediately sally forth, to join the family from which they have been separated. I say a portion, for notwithstanding their attachment to their queen, they will not all quit, without reluctance, so great a treasure as a box full of honey ; if any of the combs contain brood also, this reluctance will be increased. When therefore the bees issue slowly, the sliding shutter should be closed, and re-opened in a quarter of an hour. This short imprisonment will produce some impatience and restlessness, and consequent eagerness to be set at liberty ; and on re-opening the shutter there will be a fresh sally : this method must be pursued, at similar successive intervals, till all or nearly all the bees have quitted the box ; should a few still remain, the box, towards evening, may be taken out of doors and the stragglers brushed out upon a board or cloth, with a wing, and placed upon a support near the entrance to the stock ; those that are not injured by the wing will soon find their way in : thus will the whole

operation be completed. But if the upper story be taken, it will be obvious that either an empty box or a top board must be placed over the stock.

If this method of deprivation should fail of success, some other course must be pursued. MR. ISAAC'S *plan* promises well. After removing the box from the stock, he used to confine his bees in it, till their anger and agitation had rendered their prison so hot and uncomfortable, and probably so unwholesome, by the deterioration of the air, that they were glad of an opportunity to quit it, which he soon afforded them. Unscrewing the top of his box, and introducing a divider underneath it, he placed an empty box *over* the full one, and opened a communication between the two, by withdrawing the divider. At the same time he gave an additional impulse to the ascent of the bees by drumming smartly upon the sides of the full box. When the bees were entirely or nearly gone, he took out either the whole of the combs or such as contained honey without brood, proceeding according to the directions given in page 163. There is another resource, in *the method* uniformly *practised* by MR. KEYS, viz. that of fuming, which is effected by placing an empty box over the full one, in the manner described above, and expelling the bees with the smoke of burning puff balls, probably that of woollen rags would answer as well, though Mr. Keys relies upon the

stupifying quality of the puff balls, which however, he says, is in a great measure lost if the balls be kept more than a year. The operation may be afterwards finished in the usual way.

Where straw hives are used, or where boxes are surmounted by them, *a very simple method* of taking the honey, without destroying the bees, was *adopted by J. F. M. DOVASTON, ESQ.* a Salopian gentleman. I will suppose that he took off the hive with a middle board and divider underneath it; he then inverted it upon a kettle of hot water, fitted to receive the hive without any part sinking into the water; the whole being surmounted by an empty box, and the divider withdrawn: in ten minutes the heat so annoyed the bees, that they were heard marching, *magno cum fremitu*, into the empty hive. In a few minutes, when all was quiet, the divider being introduced again, the hive was replaced by the box containing the bees. Mr. D. found that on this plan not a single bee remained among the combs. I see no good reason why a similar practice should not be adopted with boxes or Moreton-hives; in this case the water in the kettle should be heated gradually by a chaffing-dish, and the box or hive should have a perforated divider under it, like that for uniting stocks: the empty box had better communicate with the open air, lest the heat of the steam

should be intolerable to the bees. Having the top unscrewed would probably answer the purpose, as it could then be easily pushed on one side. DR. EVANS, when he could not readily dislodge the bees from the box, had recourse to DR. WARDER'S plan of placing it over an inverted empty box, that contained a lighted sulphur match, the fumes of which stupified the bees; and on the upper hive being rapped, they fell down in a state of insensibility, but soon revived and joined the family, by the usual entrance. The fumes of sulphur answered as well as those of the narcotic fungus recommended by Thorley and Keys, which it is sometimes difficult to procure and troublesome to prepare. Immersing the bees in cold water would answer, with a glass or earthenware hive. DR. EVANS was led to adopt it in consequence of reading Wildman's account of Madame Vicat's method of clearing her bees from vermin, by plunging them in water. The chapter on Bee-maladies contains some remarks on this subject.

At the commencement of my apiarian inquiries, I felt that there was a want of more minute information than is given by Keys; and others with whom I have conversed upon the subject, have had the same feeling: this has induced me to enter into a descriptive detail of the whole business of super-hiving, nadir-hiving, and deprivation. Those who

are in possession of "*The ancient Bee-master's Farewell*," will perceive that I have made some alterations in the boxes of Keys and some additions to them: the principal of these are the sinking of the entrances in the floor boards, instead of having them cut in the lower edges of the boxes; having fixed bars upon the tops of the boxes, instead of Keys's loose ones, and the use of middle boards. The first was my own suggestion, the two last were improvements made by Mr. Walond. Entrances made in the floor boards enable the apiarian to place his boxes upon the boards in whatever direction he chooses, and render sliding shutters in the upper boxes unnecessary. The loose bars were inconvenient, from the bees attaching their combs to the sides of the boxes, which they almost always do, as well as from their attaching every comb to two or three bars. The middle boards facilitate the introduction of the dividers, secure the apiator against the effects of any little irregularity in the adaptation of the boxes to each other, at the time of adding or taking away, and form a good foundation for a superstructure of cell-work; for sometimes the bees depart from their usual practice of suspending their combs from the roofs of the boxes, and build from below upwards.

It is the usual custom in this country, to sacrifice the lives of the bees, in order to get possession

of their stores. This is generally done in September, by setting the hive, late in an evening, over lighted brimstone matches, placed in a hole dug in the earth; the soil being quickly drawn round the hive, as well to prevent the escape of any of the bees, as to confine the sulphurous gas. In about a quarter of an hour, if the hive receive a few smart strokes on its sides, the bees will be found to have dropped insensible into the hole, where they are immediately buried; otherwise they would revive, such of them at least as were not singed or otherwise injured by the fire. The heaviest and lightest hives are usually selected for the purpose, the former as yielding most profit, the latter as being unlikely to survive the winter.

If, after a hive of bees has been suffocated, the apiarian wish to *search for the queen*, the best mode of doing so is to lay the whole of the bees on white paper, or in water on a white shallow dish, and examine them singly; her colour upon the back is not so remarkably different from that of the workers as to be very striking; but on looking at the under part of her, she will be immediately recognised.

I adverted to this latter mode of robbing bees of their treasure in Chap. XIV. and there quoted the lamentation of Thomson at their fate. For

this humane appeal, he has been thus apostrophized by Dr. Evans.

“ And thou, sweet Thomson, tremblingly alive  
To pity's call, hast mourn'd the slaughter'd hive,  
Cursing, with honest zeal, the coward hand,  
Which hid, in night's dark veil, the murd'rous brand,  
In steam sulphureous wrapt the peaceful dome,  
And bore the yellow spoil triumphant home.”

## CHAPTER XXII.

## THE BEE-DRESS.

THE Storifying system, when conducted with proper precaution, in a bee-house, renders a bee-dress quite superfluous to the apiarian, as all his operations may be safely performed at all times and in all weathers, without one.

They may be as securely performed, by the storifier in a simple shed, if the time of operating be either early or late in the day, when the bees are all at home and can be confined by shutting the slide of the floor board.

Still, as timidity may foster a feeling of insecurity, and as the armour of a bee-dress may give confidence to an operator, I shall describe the dress that appears to me most suitable.

In the first place the apiator should be armed with *a pair of thick cloth gloves*, made to tie over the sleeves of his coat. Secondly, his legs should be fortified by *a double pair of thick woollen or worsted stockings*, or some kind of *stout leggings* as they are called. And thirdly, he should be provided with *a short dress of Scotch gauze or cat-gut*. This dress should be so formed as to tie round the crown of a hat having a shallow brim (about  $2\frac{1}{2}$  inches deep), should have short sleeves

to tie round the arms, and descend low enough to tie round the body. *A woollen apron* should also be worn, as high as the bottom of the catgut dress, otherwise, in the language of Mr. Keys, the prying little insects may find an opening of sufficient size to enable them to tickle the belly. "Women," says Mr. K. "should not meddle with bees, without a bee-dress, nor then without the addition of a man's coat, and I had almost said of breeches also."

This dress is the most complete mode of securing an operator from bees or wasps ; but if he be adventurous enough to brave their attacks, I recommend him first to drink or rince his mouth with a little malt liquor ; to wash his face and hands with the same, and to approach them with a bunch of sweet herbs in his hand, gently fanning his face with them, whilst he is in the vicinity of their domicile, and breathing as much as possible through his nose. (*Vide* Part II. Bee's Sting.) In case of an actual or threatened attack, (the latter of which may be known by the peculiar noise which precedes it,) a defence by striking at them would be highly imprudent. An attempt may be first made to put them gently away ; should that not succeed, the only resource is to retire quietly, and to conceal the face in shrubs or boughs, if any be near, or if not with the hands spread over it. The bees will then generally desist from further attack, and go home.

The smart quick strokes of the wings, when bees are angry and prepared to sting, give a sound very different from their usual buz. "Instead," says Mr. Hunter, "of that soft contented noise made by the bee when coming home loaded on a fine evening,—when a bee meditates an attack with its sting, it makes a very different one." There is a piercing shrillness in the sound, as the author and some of his friends have often experienced.

Messrs. Kirby and Spence, after quoting a passage from Mr. White's Natural History, relative to the feigned attacks of some wild bees near Lewes in Sussex, which "with a sharp and hostile sound dash and strike round the heads and faces of intruders," make the following observations. "The hive-bee will sometimes have recourse to the same expedient, when her hive is approached too near, and thus give you notice what you may expect, if you do not take her warning and retire.—Humble-bees when disturbed, whether out of the nest or in it, assume some very grotesque and at the same time threatening attitudes. If you put your finger to them, they will either successively or simultaneously lift up the three legs of one side; turn themselves upon their back, bend up their anus and show their sting accompanied by a drop of poison. Sometimes they will even spirt out that liquor."

## CHAPTER XXIII.

## FEEDING.

A stock of bees will, generally, consume a pound of honey per month, betwixt the 1st of October and the 1st of March : from this time to the end of May, they will consume two pounds per month ; *if the spring be unfavourable for gathering early, and less than ten pounds of honey per stock have been left for their winter's support, and that winter have proved mild, the bees should be fed early in the season, and sometimes through a considerable part of the month of May.*

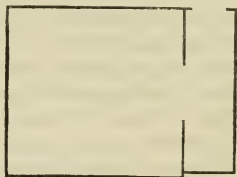
I believe the best spring food for bees is the following COMPOUND : A pound of coarse brown sugar and half a pint of ale or sweet wort, boiled to the consistence of a syrup, to which may be added a small portion of salt. According to Huber *the coarsest sugar enables the bees to form the whitest wax.* The above mixture is regarded, by some, as a useful food for bees even when there is no deficiency of honey ; *it is supposed to encourage early breeding, and to preserve the health of the bees ;* I administer it invariably from the end of February or the beginning of March till the bees seem to disregard it, which always happens

as soon as the flowers afford them a supply of honey.

There are two opinions upon *the best mode of administering the syrup*: one party gives the preference to *daily feeding, in small quantities*; the other, to *introducing a considerable quantity at once*, and repeating it as occasion may require. The majority of apiarians favour the latter practice; among the number are REAUMUR, THORLEY, ISAAC, MORRIS, &c. the latter gentleman obtained an award of ten guineas from the Society of Arts, for his method of feeding. The advocates of the first method are KEYS, ESPINASSE, and some others. Copious feeding is effected by filling the cells on one side of a spare drone comb, laid flat upon the floor of the hive; or by pouring the syrup into a dish, or an excavated floor board of twice the usual thickness, covering the food with short straws or pieces of reed, about half an inch long, to prevent the bees from soiling themselves. The stock being placed in an evening over the whole,—in the course of the night, or the following morning, the bees will carry up the syrup, and store it in unoccupied cells. Where it has been ascertained that the bees have not stored a sufficient quantity of honey to carry them through the winter and ensuing spring, and it is determined to furnish them with a supply in the autumn, I think this method of copious feeding is the best.

But when they are fed in the spring, I think it preferable to give them about a table-spoonful a day. This has generally been accomplished, by introducing into the mouth of the hive a long boat, formed by scooping out the pith from an elder stem, and filling it with the composition. Upon this plan, no more is introduced than the case requires, and frequent opportunities are afforded of learning the condition of the bees, from the manner in which they receive the boon. If a little irascibility be exhibited, it is a symptom of health ; and though indifference to the proffered bounty may not actually betoken mischief, yet it deserves attention, and should induce vigilance in the apiarian. Feeding upon the large scale in spring, tempts the bees to fill those cells which may be wanted for the queen to deposit her eggs in, and thus proves a drawback upon the strength and prosperity of the hive. It may also cause the bees to partake too freely of the syrup, and suffer from their intemperance. Whichever mode be adopted, the external entrances must be closed, during the time of feeding ; and I know of no better contrivance for this purpose than Mr. Huish's tin guards. Without this precaution, unfed stranger bees, attracted by the smell of the syrup, will banquet upon it ; and these marauders, having once tasted the repast, will not only return to it again and again themselves, but bring in

their train a multitude of others, to the great injury of the well fed apiary. The way in which I feed my own bees is exceedingly simple, and attended with no risk to the apiarian. At the close of the gathering season, I turn my boxes and their floors a quarter round, and adapt to them a long narrow box with a glass top and two openings, one at the end, serving as a street door, the other in the side serving as a hall door leading into the box, as shown in the following sketch.



In an evening, when the bees are all at home, I push in the slide of the floor board, raise the glazed box, and place the syrup under it : then I close the external entrance, and withdraw the slide to admit the bees to the food : by morning I generally find that my donation has been removed. I place the syrup in a small shallow saucer, covered over with Scotch gauze, through which the bees suck it without smearing their wings. If the gauze hang over the sides of the saucer, it

will act as a syphon, and the syrup be wasted : to obviate this inconvenience, a small hoop of whalebone, cane, or other pliable material should be just dropped within the edges of the saucer, and upon this hoop the gauze should be stretched, turned over and secured with a needle and thread.

## CHAPTER XXIV.

## DISEASES OF BEES.

I SUSPECT that much which has been written upon this subject is fanciful, and that most of the ailments of bees originate from want of cleanliness or want of food ; for if bees be not kept clean, and be not supplied with food in backward springs, particularly in those which succeed mild winters, a mortality among them is usually experienced ; and it is in spring that their alleged maladies prevail.

“ For late the lynx-ey’d scout, in nice survey,  
Had mark’d the ravage of ungenial May,  
Where the lorn bee-herd wail’d his empty shed,  
Its stores exhausted, and its tenants dead.”

“ So mourn’d Arcadia’s swain\* his honey’d host,  
By keen disease or keener famine lost,  
Till his fond mother, on her glassy throne,  
Heard through deep Peneus’† wave the filial moan.”

EVANS.

During a mild winter the stock of honey is often exhausted, such a season encouraging the bees to

\* Aristæus, the son of Apollo and the nymph Cyrene, to whom mankind were said to be indebted for the art of curdling milk, *managing bees, making hives*, and cultivating olives ; on which account he was worshipped as a God by the Greeks. He was the father of the unfortunate Actæon.

† A river of Thessaly.

be active, without affording any resources beyond their own domicile ; yet it is not uncommon to hear the keepers of bees speak of a mild winter as favourable for the bees. It is most unfavourable to them ; and if feeding be not duly attended to, frequently fatal. Hence *a northern aspect* has been *recommended* for hives *during winter* ; and if guarded by proper coverings, and contrivances against snow and other bad weather, such an aspect is highly proper. THE REV. STEPHEN WHITE observes, that if hives be placed on the northern side of a building, the bees will seldom be induced to come out, and will eat much less than if exposed to the winter's sun. MR. GEDDE *recommends* keeping them during winter, *not only in a cold, but in a dark situation*, in order to lessen the consumption of honey. He even suggests the use of an ice-house, having found that bees survive the cold in Siberia, and render Russia somewhat remarkable for its productiveness of honey. "A very observing gentleman," says DR. DARWIN, "at my request, put two hives for many weeks into a dry cellar, and observed, during all that time, that they did not consume any of their provision, for their weight did not decrease, as it had done when they were kept in the open air." The same observation is made in the Annual Register for 1768, p. 113. The sudden transitions from heat to cold, and from cold to heat, experienced

in this country, are detrimental to bees ; but these vicissitudes would not alarm me, if the bees were well sheltered, and had a convenient supply of water, salt and sugar, in the early part of the spring.

Keys thought they were not fond of salt : from my own experience as well as from that of my apiarian friends, I am satisfied that he was mistaken, and my opinion is confirmed by the following observation in Crèvecoeur's Travels. " One day, having remarked that my bees frequently settled on spots, where brine had been spilt, I placed some grains of salt before their hives. What was my astonishment, when I saw them repeatedly tasting it with eagerness, and carrying it away with them ! Before this experiment, I could not have believed that the manufacturers of honey could taste with pleasure, a substance so different from the nectar of flowers."

*In the winter of 1782-3, a general mortality took place among the bees in this country, which was attributed to various causes : want of honey was not one of them ; for in some hives considerable store was found, after the bees were gone. Some were of opinion that it arose from the preceding being a bad breeding year, and thought the bees died of old age. Others attributed it to the moistness of the spring of 1783, which rendered the providing of pollen difficult, for without pollen*

no brood can be raised. The difficulty of collecting pollen was ascribed to the continual closing of the flowers over the anthers, the want of sun to burst the anthers, and the washing away of the pollen by the frequent showers after they did burst. The fatal influence ascribed to the wetness of the spring of 1782 seems to be improbable; though the wet might have affected the quantity of bees bred, it was not likely to put a stop to their breeding altogether, and the young bees ought at any rate to have escaped the desolating evil, if it were old age alone; yet wherever the mortality once made its appearance, every bee became its victim.

*A similar incident occurred among the wasps in the year 1824.* The queen wasps were unusually numerous in the spring of that year, and yet scarcely a wasp could be seen of any sort in the ensuing summer and autumn, though there was a great deal of fine weather and plenty of sunshine, the fruits having ripened remarkably well. In both cases, it seems probable that the mortality arose from some unfavourable circumstance at the breeding season, with which we are unacquainted. I am not aware that it has been attributed to any specific distemper of an epidemical nature. MR. KNIGHT noticed a similar occurrence, as to wasps, in the year 1806 (*Philosophical Transactions* 1807, p. 243); and in 1815, MESSRS. KIRBY and SPENCE

*made the same observation.* Mr. Knight supposed the scarcity to arise from a want of males to impregnate the queens.

I shall now proceed to notice the maladies of bees ; and state their causes, symptoms and remedies, as I have collected them from ancient and modern authors.

### DYSENTERY.

This malady was attributed by COLUMELLA to the bees extracting and feeding upon honey collected from the blossoms of elms and spurge ; he regarded it as an annual distemper. By others it has been ascribed to their feeding too freely upon the vernal honey, from whatever source derived ; or from their being obliged to eat wax, through want of other food, in the early part of the spring. MADAME VICAT supposed it to arise from the feeding upon honey that had been candied, in consequence of the hive being exposed to a severe winter. REAUMUR instituted some experiments to ascertain the cause of dysentery, but they were not satisfactory.

The presence of this disorder is indicated by the appearance of the excrement, which, instead of a reddish yellow, exhibits a muddy black colour, and has an intolerably offensive smell. Also by its being voided upon the floors, and at the entrance of the hives, which bees, in a healthy

state, are particularly careful to preserve clean. HUISSH compares the morbid excrement to linseed.

### VERTIGO.

*Vertige*, as DU CARNE DE BLANGY calls it, is supposed to arise from the bees extracting the honey of deleterious plants. I have treated fully upon this subject under the head of Pasturage. In addition to what has been there stated I will give an extract from DR. BARTON'S *Paper*, who after observing that there is more poetry than philosophy in the following lines of Pope—

“ In the nice bee what sense so subtly true  
From poisonous herbs extracts the healing dew?”

says: “It is however much to be questioned whether this noxious honey proves so to the bees themselves.” Sir J. E. Smith asserts that “the nectar of plants is not poisonous to bees.” *Syllabus to Botan. Lect.* And Dr. Barton, though disposed to adopt the contrary opinion, gives instances to the same effect. Thus a party of young men, induced by the prospect of gain, having removed their hives from *Pennsylvania* to the *Jerseys*, whose vast savannahs were finely painted with the flowers of the *Kalmia angustifolia*, could not use or dispose of their honey, on account of its intoxicating quality; yet, “the bees increased prodigiously,” an increase only to be explained by their being well and *harmlessly* fed.

This disorder is marked, we are told, by a dizzy manner of flying, and by irregular motions, such as starting, falling down, &c. when the bees are pursuing their usual occupations. To these symptoms succeed lassitude and death. No remedy has hitherto been discovered for this malady.

HUBER says that *vertigo attacks ants*, and causes them to lose the power of moving in a straight line, and occasions the performance of rapid gyrations always in the same direction: he observed one insect make about 1000 turns in an hour, describing a circle of about an inch in diameter; this continued for seven days: he does not say whether he ever knew any instance of a recovery.

In Dr. Barton's ingenious paper, to which I have already referred in the chapter on Pasturage, the plants enumerated as yielding poisonous honey are *Kalmia angustifolia*, *latifolia*, and *hirsuta*; *Rhododendron maximum*, *Azalea nudiflora*, and *Andromeda mariana*. The honey of these is stated to have proved injurious both to dogs and the human species. *The symptoms* it usually produces are *dimness of sight or vertigo, delirium, ebriety, pain in the stomach and bowels, convulsions, profuse perspiration, foaming at the mouth, vomiting and purging*; in some instances, *temporary palsy of the limbs*, but very seldom death. The best mode of *treatment* is not yet ascertained; though the similarity of the symptoms, the Doctor

says, would induce us to pursue the same plan as in counteracting other narcotic poisons. In those cases, *early vomiting*, whether spontaneous or induced by art, removes the disease at once; and *cold bathing*, so useful in other spasmodic or convulsive affections, is employed with considerable advantage by both Natives and Europeans. This should seem to be one of those cases in which *the stomach-pump* would be peculiarly beneficial, from the promptness and certainty of its action.

To the credit of the genus of plants last named, it should be mentioned that one species (*Andromeda nitida* or *lucida* of BARTRAM) affords abundance of excellent honey; hence the name of *honey-flower* is given to it, by the country people in *Georgia* and *Carolina*, not however merely from the circumstance just mentioned, but from the regular position of the flowers on the peduncle, which open like the cells of a honey-comb, and from the odour of these flowers, which greatly resembles that of honey."—*Barton*.

"As most of the plants enumerated in the above list are now introduced into our gardens, and the *Datura* (*common Thorn Apple*) has long become perfectly naturalized, they might be supposed to injure the British honey. Most probably, however, their proportion to the whole of the flowers in bloom, is too small to produce any such inconvenience; whereas on their native continent

they exclusively cover whole tracts of country, as instanced above in the Jerseys." *Evans*, B. ii. p. 95.

#### TUMEFACATION OF THE ANTENNÆ.

The antennæ, in this disorder, become swelled at their extremities, which resemble the bud of a flower ready to open, and they assume a yellow colour, of which the forepart of the head shortly partakes; the bees becoming gradually languid and dying, if they have not timely assistance.—This malady occurs about the month of May.

PESTILENCE, or FAUX COUVAIN (*as Schirach calls it*).

Pestilence has been reckoned among bee-maladies, and attributed to the residence of dead larvæ in the cells, from a careless deposition of ova by the queen, (the head of the grub not being placed in a proper position for exclusion, when that period has arrived,) it has also been ascribed to cold, and to bad nursing, that is, feeding with unwholesome food.

#### TREATMENT.

The remedies which have been found most successful in all these maladies, excepting vertigo, are *cordials*, namely *wine* and *sugar*. This circumstance, taken in conjunction with their occurring at the spring of the year, tends to confirm my opinion that the ailments of bees arise from hunger and filth.

*Cleanliness and timely supplies of sugared ale*, particularly during the months of February and March, are the preventive remedies which have hitherto preserved my bees in a state of healthful activity. In ungenial springs, feeding should be continued even *through a considerable part of May*, if the preceding autumn have been unfavourable, or if a cold May have succeeded to warm weather in early spring,—the earliest vernal flowers affording but a scanty supply of honey. The apiarian is sometimes astonished that he should lose his bees at this advanced season of the year, when but a short time before he had seen them in full health and activity. Had he afforded that food which his bees could not obtain from a comparatively immature and honeyless vegetation, their lives would still have gladdened him with the spectacle of a thriving population.

“If e'er dank autumn, with untimely storm,  
The honey'd harvest of the year deform,  
Or the chill blast, from Eurus' mildew wing,  
Blight the fair promise of returning spring,  
Full many a hive but late alert and gay,  
Droops in the lap of all-inspiring May.” EVANS.

The reader must now perceive the importance of feeding, and that the transition from health to languor and death is less frequently to be ascribed to disease, than to the want of the necessary

means to continue the vital energy. The suddenness of the unhappy change may reasonably lead the uninformed or improvident to suppose that an incurable malady has visited their hives:—so long as the store of honey lasted, there were health and prosperity; but that gone, famine commenced its ravages, and an extinction of the bees of course followed. A little foresight and a little trouble would have kept off the calamity. I am perhaps tediously particular in this notice. I wish to impress my noviciate bee-friends with the necessity of thus providing for their hives, that the most frequent agent of mischief,—hunger,—may be kept out of them. Still further let me also recommend to them, on the approach of winter to have the floors of their hives or boxes well cleaned from insects and their eggs, and from all heterogeneous matter. This is a business which the bees themselves, when the weather admits of it, are particularly attentive to; indeed they refrain, as much as possible, from dropping their excrement upon the floors, taking advantage of every fine day in winter to sally forth and get rid of it. This was proved by the experiments of Mr. Hunter: indeed they sometimes fall a sacrifice to their personal neatness in this respect, their bodies becoming so swelled, from the accumulation of fæces, as completely to disable them from flying, when the wea-

ther is sufficiently favourable to admit of their going out; in consequence of which, they fall to the ground and perish.

SCHIRACH and others recommend, in cases of *Faux Couvain*, to cut out the infected combs, and to clean and fumigate the hive by burning aromatics under it.

IN BUTLER'S *Feminine Monarchie*, we are gravely told of a certain bee-mistress, who, finding her hives fruitless, and their tenants pining away with sickness, by the advice of another female, went to receive the eucharist, and having kept it in her mouth, placed it, on her return home, in one of the diseased hives. The plague ceased; honey accumulated; and, on examining the inside, she found a waxen chapel and altar, of wondrous architecture, and even bells of the same materials. —Gent. Mag. 1809. p. 316.

To prove that there is much of fancy in the traditional accounts respecting bee-maladies, I will mention *the various hypotheses concerning dysentery*. COLUMELLA speaks of its arising from the bees feeding upon honey collected from elm and spurge blossoms: my own neighbourhood abounds with both; but I never met with nor scarcely heard of dysentery among the bees here. EVELYN in his *Sylva* expresses doubts upon the subject; and DR. EVANS says he made particular inquiries of some friends in Worcestershire, which

(like this county—Herefordshire) abounds with elms, without obtaining satisfactory information.

Dysentery has also been said to be produced by a surfeit of vernal honey, simply as such, from whatever flowers derived: were this true it would occur in all neighbourhoods. With respect to its proceeding from their eating wax, I am decidedly of opinion that wax never constitutes any part of their food, under any circumstances; not a tittle of evidence can be adduced in support of such an assertion. Wax is an excrementitious matter, secreted among the abdominal folds of the bees for the sole purpose of constructing the honey and brood combs: the scraps of wax that are observed in winter and spring upon the hive floors, and which, to the minds of common observers, convey the idea that they are crumbs caused by the bees consuming the wax for food, are produced by their nibbling the lids of the cells to uncover the honey. If MADAME VICAT's *theory* were correct, what would become of all the bees in Siberia and other northern regions? Huish says he never found honey in this country to candy in the combs, but adds that Bonner assured him that *he* had experienced it. *Vide* chapter on Honey.

KIRBY and SPENCE have given it as their opinion, that dysentery arises from the bees having an insufficiency of pollen or bee-bread to

eat with their honey. We have no evidence that pollen constitutes any part of the food of *adult* bees ; and if it did, they have generally opportunities of storing it very abundantly, in the autumn, as well as in the spring : and such is the provident industry of bees, that a considerable surplus is always found in every stock-hive.

WILDMAN and HUSH recommend salt for preserving the health of bees ; and their frequenting stable drains and other receptacles of urine gives countenance to this recommendation, as it seems probable that the saline matter contained in those fluids attracts the bees, their desire for it overcoming that repugnance to offensive odours which would otherwise occasion them to avoid such places. Even fresh urine has been recommended by RANCONI, an *Italian* author, in case the bees should be attacked by dysentery ;—in all probability a weak solution of salt would be more acceptable and equally efficacious. I always introduce a small portion of it into the syrup with which I feed my bees. KEYS says that they are not fond of salt. *Vide* Page 186.

I will close this chapter on the Diseases of Bees with an extract from Nicholson's Journal, vol. xxiii. p. 234 : Scientific Intelligence.

“ A large swarm of bees having settled on a branch of the *poison ash*, (*Rhus Vernix*), in the county of West Chester in America, was taken

into a hive of fir at three o'clock in the afternoon, and removed to the place where it was to remain, at nine. About five the next morning the bees were found dead, swelled to double their natural size, and black, except a few, which appeared torpid and feeble, and soon died on exposure to the air." This was attributed to their being poisoned by the effluvia of the *Rhus Vernix*.

## CHAPTER XXV.

## ENEMIES OF BEES.

AMONG the enemies of bees are enumerated various kinds of birds, poultry, mice, wax-moths, slugs, hornets, wasps, woodlice, ants, and spiders.

The most destructive enemies of the bee, in this country, are *wasps*, whose superior strength, boldness and number, enable them to commit great ravages in a hive. One wasp is supposed to be a match for three bees, and, to filch a belly-full of honey, will oppose a host of bees in a very daring manner.

The *wax-moth* (*Tinea mellonella*) is also a dangerous enemy. MR. ESPINASSE says that this is the smallest of the genus, and it is of a whitish brown colour. The butterfly usually appears about weak hives in April, and may be seen till the end of October. This insect is remarkably active in its movements; and if the approach to the hives be observed of a moonlight evening, the moths will be found flying, or running round the hives, watching an opportunity to enter; whilst the bees that have to guard the entrances against their intrusion, will be seen acting as vigilant sentinels, performing continual rounds near this important post, extending their antennæ to the utmost, and

moving them to the right and to the left alternately. Woe to the unfortunate moth that comes within their reach! "It is curious," says HUBER, "to observe how artfully the moth knows to profit, to the disadvantage of the bees, which require much light for seeing objects; and the precautions taken by the latter in reconnoitring, and expelling so dangerous an enemy." Adroitly gliding between the guards, the moths will often contrive to insinuate themselves, unperceived, into the hives, and riot upon the honey. When they have obtained possession, they deposit their eggs upon the sides of the combs; the caterpillar is formed and inclosed in a case of white silk; at first, it is like a mere thread, but gradually increases to the size of a quill, and during its growth feeds upon the wax around it. It seems very extraordinary, and would be almost incredible if the fact were not well attested, that such tiny creatures should live in the midst, and at the expense of myriads of such formidable insects as bees, protected as they are by coats of mail, armed with weapons of offence, and ever watchful of their treasure. Such, however, is the havoc sometimes made by these apparently insignificant, but active enemies, as now and then to compel a colony of bees to emigrate, and seek another habitation.

In this country, where the apiary is generally

situated near the dwelling, *birds* do not commit any great ravages. MR. ESPINASSE thinks that in general they come only for *dead bees* and *larvæ*, which may have been thrown out of the hives. But in America, according to MR. HECTOR ST. JOHN, *the king bird*, the protector of corn-fields from the depredation of crows, is a great destroyer of bees. After shooting these birds, Mr. St. John has found bees in their craws, from one of which he took as many as a hundred-and-seventy-one: on laying them all on a blanket in the sun, fifty-four of them returned to life, licked themselves clean, and joyfully went back to their hives. Many wonderful tales of this kind have been told,—such as the recovery of flies that had been inclosed for a considerable time in bottles of liquor (madeira). An instance of this is related by Wildman, who says his informant was a very ingenious and accurate gentleman:—that the madeira had been brought, in bottle, from Virginia to London, and that the flies when exposed to a warm sun for an hour or two, were so completely reanimated, as to take wing; thus putting to the test, as Wildman's friend observed, the truth of the opinion, that a fly cannot be drowned.—A very marvellous tale was related last year in the newspapers, of the recovery of some apparently dead bees after the substance containing them had been submitted to a considerable heat

or to a chemical process. Mr. St. John's statement is within the bounds of credibility: it seems to have been a case of suspended animation of short continuance, not produced by exposure to gas or to any liquid likely to prove deleterious to them; and it is well known that bees often recover even after suffocation with sulphurous gas.

Bees may be immersed in water for a long time, without loss of life. Reaumur saw them recover after nine hours immersion. Dr. Evans accidentally left some eighteen hours in water; when laded out with a spoon and placed in the sunshine the majority of them recovered. Other animals, of analogous species, exhibit still more wonderful resurrections. DeGeer has observed one species of mite to live for some time in spirit of wine; and Mr. Kirby states that being desirous of preserving a very pretty lady-bird, and not knowing how to accomplish it, he immersed it in geneva. "After leaving it," says he, "in this situation a day and a night, and seeing it without motion, I concluded it was dead, and laid it in the sun to dry. It no sooner, however, felt the warmth than it began to move, and afterwards flew away." This circumstance laid the foundation of Mr. K.'s study of entomology.

Of this adherence to life, advantage has been taken at the time of deprivation,—recourse having been had to immersion for removing a portion of

the combs, the bees were afterwards spread on a cloth in the sun, and became reanimated. Dr. Derham says that he has known bees revive after remaining twenty-four hours under an exhausted air-pump. After long submersion the proboscis of the bee is generally unfolded, and stretched to its full length. The first symptom of returning animation, is a motion at its extremity, succeeded by a similar motion at the extremities of the legs. Having so far progressed towards recovery, the tongue is soon folded up again, and the bee prepared to resume its customary occupations.

*Moths* and *spiders* should be watched and destroyed in an evening, as at that time the former are hovering about, and the latter laying their snares; at that time too there would be less danger of annoying the bees, or of being annoyed by them. Wherever moths have gained possession of a hive, it is always necessary to destroy the bees, or to drive them into another hive.

Attention to the following particulars may guard the bees from many of their enemies. A frequent cleaning of the hive floors; the use of new or well cleaned hives; the timely renewal of the coverings, and keeping the ground bare around the apiary, particularly in front of it. This last precaution may also prevent the entanglement of the bees in rubbish or long straggling vegetables,

should they on their return home fall down through fatigue or the weight of their loads.

From *rats* and *mice* the surest safeguard is an appropriate position of the hives; traps may also be laid, and in winter the entrances into the hives contracted. It will be prudent likewise to case the legs of the bee-benches with tin. Bees in a healthy vigorous state will attack and kill an intruding mouse; but in winter it might commit great depredations, and cause the emigration of the bees on the return of warm weather. (Mr. Espinasse says that he has known a mouse take up his winter quarters in a hive, without destroying the bees.)

For protection against *ants*, which sometimes enter the hives and eat the honey, Mr. COBBETT, in his *Cottage Economy*, recommends that the pedestals or legs of the benches supporting the hives should be surrounded by a green stick, twisted into a circular form and covered with *tar*; and if the ant nest can be traced, that *boiling water* should be poured into the centre of it, at night, when all the family are at home. The tarring of the stick should be repeated every two or three days: the legs of the stool, or the posts on which the shed stands, may also be tarred. Some bees may be lost by sticking in the tar, but this disadvantage will be more than counter-

balanced by the destruction of the ants. *Slaked lime* may be beneficially spread about a foot wide round the apiary. The usual custom has been to renew this sprinkling of lime every two or three days: but the *experiments* of Mr. COLERIDGE (Southey's Brazil, i. 645) show that this step is unnecessary: by exposure to the air, lime is converted into chalk; and according to Mr. C., (who states that the formic acid transpires from the bodies of ants so as to leave its traces upon the substances which they traverse,) if ants attempt to pass over chalk, the effervescence produced between the chalk and the acid will be so considerable as to burn their legs. It has been said that a bee cannot kill an ant, when bitten; but that the bee instead of making resistance, flies away and carries the ant with it.

M. REAUMUR was of opinion that ants were not to be reckoned among the enemies of bees; and he relates an instance of their living as very close neighbours, yet in perfect harmony. The ants established themselves between the glass panes of his bee-box and the wooden shutters which covered them; and as a similar circumstance occurred to BONNET, and in other of Reaumur's hives also, it seems probable that the ants took up their quarters in this situation for the sake of the equable warmth that the bees would impart to their eggs. "Ants were with-

out the hive," says Reaumur, "and bees within ; a single glass only separating two nations, so different in manners, in customs, and genius. The bees were abundantly provided with a dainty of which ants are exceedingly fond, I mean honey. The ants had just reason to be apprehensive that the bees would be uneasy, and jealous to preserve so precious a treasure. Nevertheless the utmost harmony and concord prevailed between the two nations. Not a single ant was tempted to enter the hive, how strongly soever she might be invited by the fragrance of the honey ; nor did any bee disturb the ants, though superior to them in power ; the several individuals, on each side, went in and out peaceably ; they would meet in the way without teasing or molesting one another : respect on one side, and complacency on the other, were the foundation of this peace."—Nat. History of Bees, p. 352.

The destruction of *queen wasps* and *queen hornets* in the spring, and of wasps' and hornets' nests in the summer, will prove the best security against those formidable enemies. None but queen wasps and queen hornets appear in the spring. Every one which is then annihilated would probably have been the founder of a kindred colony, and every colony of wasps at a moderate computation may be calculated to produce at least 30,000 in a season. These destroyers may often be watched to their homes and

exterminated in the night, by brimstone, gunpowder, or boiling water.

The wooden guards invented by Espinasse, or the tin guards of Huish, will be very useful in case of a formidable attack, and had better be made use of if an assault be apprehended from these predatory insects.

Powder and shot are the only protectors from the visits of *birds*.

The exclusion of *poultry* must be left to the ingenuity of the apiarian.

In an ungenial autumn, it is not uncommon for *bees that are ill-managed and not properly fed, to plunder the hoards of their own species*, and bees that have thus acquired predatory habits, become great annoyers of industrious and well fed colonies; they are known by the name of *corsair bees*. On these occasions spies are said to be sent out to ascertain the respective strengths of neighbouring colonies, and to select the weakest for attack. *They make similar attacks upon the nests of humble-bees, as well as upon the bees themselves*; in the former case they will carry off almost the whole of the stores that have been collected, unrepulsed by its proprietors; and in the latter case, says HUBER, "the humble-bee, accustomed to such exactions, yields up its honey, and resumes its flight." In both cases it renews its labour in the fields, and repairs with its surplus

treasure to its usual asylum, and that even after repeated robberies. MR. HUBBARD says that he has known repeated instances of weak stocks being expelled from their hives by strong ones. *The best remedies for this evil are the contraction of the entrances, as for guarding against wasps, or a change in the situation of the hives.*

DR. DARWIN in his *Phytologia* has related an instance of a besieged hive being removed to a distant and more easterly part of the same garden : the assailants in this case did not follow, and the bees resumed their usual occupations. Removal to a still greater distance would seem to promise more certain relief. In order to raise their courage above its natural height when thus attacked, SCHIRACH recommends *mixing a little wine or brandy with honey, and presenting it to the bees that are besieged.*

HUBER has called the attention of Naturalists to what he designated as *a new enemy of bees*, the *Sphinx Atropos* or *Death's-head Hawk-moth*, to which his attention seems to have been first directed in 1804. This gigantic moth, which derives its name from having upon its back a mark somewhat resembling a death's head, has, from this cause together with its size, (which at first caused it to be mistaken for a bat,) produced great alarm amongst the people of some countries, being regarded by them as the harbinger of some

calamity. KUHŃ speaks of its having been noticed in the apiaries of some monks at the close of the last century, as well as in the bee-houses of other persons : and CAMPBELL, in his *Travels*, mentions it as plundering the wild bees in *Africa* of their honey. This moth makes its appearance towards the close of summer : it has the faculty of emitting a shrill mournful cry, which, when threatened by the vengeance of the bees, has the power of disarming their fury. It operates upon them like the voice of their queen, and thus enables the moth to commit the greatest ravages in the hives, with perfect impunity. Huber ascertained that it could not produce the same effect upon humble-bees ; for whenever *their* nests are entered by one of these insects, it is immediately attacked and driven out. One that Huber introduced into a nest of humble-bees was actually stung to death by them, but not till many wounds had been inflicted upon its most sensible part, the belly. On dissecting one of these moths, he found a table-spoonful of pure honey in its abdomen. The proceedings of bees, when attacked by the *Sphinx Atropos*, as detailed in the Chapter on Instincts, will suggest to the apiarian the best plan to be adopted, whenever this formidable insect shall invade their territories.

## CHAPTER XXVI.

## EXOTIC BEES.

BEES are, in all probability, the most universal of all animals; and notwithstanding their impatience of cold, they seem adapted to live in all climates. They are accordingly to be met with in every quarter of the globe, and in every quarter they seem to flourish, if duly attended to.

*In all tropical climates there are little black bees without stings.* Those of Guadaloupe are only half the size of those in Europe, and are rounder in their form. They build in hollow trees, or in the cavities of rocks by the sea-side, where they lay up their honey in cells about the size and shape of a pigeon's egg; these cells are of a black or deep violet colour, and joined together, so as to leave no space between them; they hang in clusters almost like a bunch of grapes; each cell somewhat resembles a small bottle or bladder; when filled with honey the cell is closed up.

The honey collected by these bees is said not to be so unpalatable nor so surfeiting as that of Europe. By unpalatable I conceive the writers merely to mean, that it has less of that peculiar flavour which European honey possesses. A writer in the 15th volume of the Philosophical

Transactions, states that their honey is always in a fluid state, and as clear as rock water, forming an agreeable beverage, which taken on an empty stomach in the quantity of about half a pint, acts medicinally in about two hours, but not so when taken with the meals.

There is a species of bees in Guiana which gather very delicious honey, and have no stings. These also construct their combs in a different manner from the hive bee of our hemisphere. According to Huber's translator, *there are bees in India that construct under the boughs of a tree a single comb of very large dimensions.* The most interesting account of exotic bees that I have met with, is in Mr. Basil Hall's highly instructive and entertaining Journal written on the coasts of Chili, Peru and Mexico, in 1820, -1, and -2, of which I shall here give a transcript.

"From the Plaza, we went to a house where a bee hive of the Country was opened in our presence. The bees, the honey-comb, and the hive, differ essentially from those in England. The hive is generally made out of a log of wood from two to three feet long and eight or ten inches in diameter, hollowed out, and closed at the ends by circular doors, cemented closely to the wood, but capable of being removed at pleasure.

"Some persons use cylindrical hives, made of

earthenware, instead of the clumsy apparatus of wood ; these are relieved by raised figures and circular rings, so as to form rather handsome ornaments in the verandah of a house, where they are suspended by cords from the roof, in the same manner that the wooden ones in the village are hung to the eaves of the cottage. On one side of the hive, half-way between the ends, there is a small hole made, just large enough for a loaded bee to enter, and shaded by a projection to prevent the rain from trickling in. In this hole, generally representing the mouth of a man, or some monster, the head of which is moulded in the clay of the hive, a bee is constantly stationed, whose office is no sinecure\*, for the hole is so small, he has to draw back every time a bee wishes to enter or to leave the hive. A gentleman told me that the experiment had been made, by marking the sentinel ; when it was observed that the same bee continued at his post a whole day.

“ When it is ascertained by the weight that the hive is full, the end pieces are removed, and the

\* If the Mexican bees enter the hives with as much rapidity and in as great numbers as Reaumur states they do in this part of the world, it would indeed be no sinecure. He observes that the population of a hive amounts to 18,000, and that a hundred enter in a minute ; if as many go out in the same time, I think the sentinel must rather stand on one side of the entrance than within it,

honey withdrawn. The hive we saw opened was only partly filled, which enabled us to see the economy of the interior to more advantage. The honey is not contained in the elegant hexagonal cells of our hives, but in wax bags, not quite so large as an egg. These bags or bladders are hung round the sides of the hive, and appear about half full, the quantity being probably just as great as the strength of the wax will bear without tearing. Those near the bottom being better supported, are more filled than the upper ones. In the centre of the lower part of the hive, we observed an irregular-shaped mass of comb furnished with cells, like those of our bees, all containing young ones, in such an advanced state that when we broke the comb and let them out, they flew merrily away. During this examination of the hive, the comb and the honey were taken out, and the bees disturbed in every way ; but they never stung us, though our faces and hands were covered with them. It is said, however, that there is a bee in the country which does sting ; but the kind we saw seem to have neither the power nor the inclination, for they certainly did not hurt us ; and our friends said they were always 'muy manso,' very tame, and never stung any one. The honey gave out a rich aromatic perfume, and tasted differently from ours, but possessed an agreeable flavour."

From the periodicals of the last year, I have

observed that there has been an importation of the stingless bees into this country. I doubt the success of their establishment here, as the fruits of their labours may very soon become the prey of wasps and corsair bees, and even of the hive bees which, in a dearth of honey or when from a paucity of numbers a hive is weakly defended, will commit depredations upon one another. The stingless bees having no weapon of defence which enables them to cope with armed assailants must soon be exterminated. In their native clime, where there is an abundance of sweets, no temptations to predatory attack may occur; but in our hemisphere, as Buffon has observed, there are hundreds of lazy creatures, fond of honey and disliking labour, that would, but for the weapons of defence possessed by our bees, invade their hives and carry off the treasures.

Honey-bees do not appear to have been among the native productions of North America, though they have now become general throughout that continent. When established there, they extended themselves somewhat in advance of the white population; in consequence of which they were called by the native Indians, the white man's flies, and were regarded as indicating the approach of European settlements.—Jefferson's Virginia.

An elegant modern writer has observed upon this subject, that “a few years ago the hum of a

bee had never been heard on the western side of Alleghany Mountains : but that a violent hurricane having carried several swarms over that lofty ridge, they found there a new unexhausted country, singularly favourable to their propagation, where they have multiplied, till the whole of those boundless savannahs and plains have been colonized by these indefatigable emigrants."

From what I have said above, it would seem that the bees of all tropical climates store their honey in cells or bags of large dimensions ; but from Mr. Basil Hall's account it appears that the bees of South America build small cells also, resembling those of our hive-bees ; and in all probability this is the case with those of other hot climates, and that these small cells are merely used as receptacles for the young brood.

## CHAPTER XXVII.

## SEPARATION OF WAX AND HONEY.

AFTER deprivation, the box or hive containing the combs should be kept in a warm room, till it is convenient to drain it of its contents, as the more fluid the honey, the sooner and the more completely will it run off; this is of course a reason for not deferring the draining longer than can be avoided.

The combs should be separated from the boxes or hives with the broad spatula and the double-edged instrument recommended in chapter XI. and placed afterwards on a clean dish. The waxen covers, on both sides of the sealed combs, should be sliced off, when by placing them on a hair sieve the honey will run through tolerably fine, and may be caught in an earthen pan. For prime purposes the purest combs should be selected, and their honey passed through a separate sieve. Mr. Isaac recommends letting this fine honey drop through the sieve into a silk sarse, such as is used by the apothecary for sifting fine powders, and from the sarse into an earthen pan; this would enable the apiarian to obtain his honey in a more depurated state. The sarse must be first wetted, or the honey will not run

through it. If the weather be cool, this business should be done in a room where there is a fire.

The ordinary combs may be chopped up, or broken down with the hands, and together with the refuse combs after draining, may be thrown into as much clear water as will cause the wax to swim : the whole may remain in this state for some days to dissolve all the honey for making common mead ; or the combs may be spread out upon broad dishes, and set before the bees in an evening, as also the utensils which have been employed during the process, first strewing them over with short straws, to prevent the bees from smearing their wings. The former is the best mode of disposing of the refuse combs and utensils, as the latter is apt to produce quarrelling and robberies.

The combs having been cleared as completely as possible, the finest should be boiled in water enough to float them, till they are thoroughly melted : the melted mass should be poured into a canvass bag, made in the form of a jelly bag, with a draw tape or string at the top, and then be suspended over a tub or pan of cold water. The strings of the bag being tightly drawn, the expression may be effected in various ways. Some press the bag between two strong round sticks, tied or strapped together at their ends, so as to resemble a pair of nut-crackers, with which two

persons may by repeatedly stripping down the sides of the bag, express the whole of the wax. Others express it by making an inclined plane of a board about four feet long, placing one end of it in the tub or pan of water, and the other against the breast of the assistant, who puts the bag on the board and passes a round stick firmly down it, as long as the wax will run. A screw press, made hot, would of course answer the purpose better than either of the above modes.

The crumbled combs might be put over the fire, in a steam kettle, with water under it, and the wax which runs through might be afterwards melted again and passed through the bag. The new combs will melt almost entirely; but the old ones, owing to their cells having received so many linings, will preserve their form, the wax running from them but in small quantities.

The vessel used for melting the wax should be capable of containing a good deal more than is put into it, as the contents may boil up suddenly, and occasion loss and inconvenience as well as danger. The wax having been separated from the water in which it was melted, should be remelted with just water enough to prevent burning; and having been well skimmed, may be poured into proper moulds for forming cakes, the vessels being first rinsed with cold water to

prevent the wax from adhering to them. The melted wax should be placed near the fire and covered over, to cool gradually, or the cakes will be liable to crack. If it be desirable to have the wax in a very pure state, it may be boiled over and over again with fresh water.

## CHAPTER XXVIII.

## WAX.

WAX is a solid compact unctuous substance, generally of a yellow colour. It is secreted by animals and vegetables, but the vegetable secretion of it is often combined with resin.

BEES-WAX may be said to be a concrete animal oil, holding the same relation to the fixed oils that resin does to the essential oils. It is secreted by certain small sacklets on the body of the bee, as occasion requires, for constructing the combs in which the family provision and the young brood are deposited ; the wax of commerce is procured by melting down these combs, in the manner already described.

*Prime wax* is of a bright yellow colour and an agreeable odour, somewhat like that of honey. The best is procured from combs which have been either wholly unoccupied, or occupied by nothing but honey. When first secreted, it is white, semitransparent, and very fragile : it afterwards becomes stronger, and assumes more or less of a yellow hue. This deepening of colour is owing, partly, to its being covered with a yellowish varnish by the bees, (for an account of

which see "Architecture" and "Propolis,") and is partly the effect of age.

Independently of its colour, the goodness of wax may also be estimated by the passing of the thumb nail forcibly over its surface : if good, the nail will pass with a kind of jerk ; but if no obstruction be felt, the wax may be looked upon as adulterated with suet, or some similar substance.

The average *quantity yielded by a common hive*, is about half a pound of wax to fifteen pounds of honey ; the quantity of both may be considerably increased by storifying.

WHITE WAX is nothing more than the yellow wax that has been exposed in thin flakes or shreds to the action of the sun and air. There is an apparatus for melting and reducing the wax into shreds or ribbands, but the process of conversion, under any circumstances, is tedious and dependent on the weather. "The following," says Mr. Parkes in his Chemical Essays, "is the usual process, as it is conducted in England. Common bees-wax is melted upon hot water ; and when in a fluid state, it is laded out of the copper, together with a part of the water, into a wooden vessel ; and in this it is allowed to remain a few hours, for the impurities to subside from it. The purified wax is then put, while still hot, into a cullender full of holes, through which it runs, and falls upon a revolving metallic roller, which dips

into cold water contained in a vessel placed underneath. As the melted wax runs through the cullender upon the revolving roller, the motion of the cylinder forms it into thin shavings, which cool as they come in contact with the water, and fall in an accumulated heap into the water below. These shavings of wax, being now in a suitable form for absorbing oxygen, are taken out of the tub, and exposed in a field to the action of the atmosphere, till they become sufficiently white."

Bees-wax forms *a considerable article of commerce*, and large quantities of it are annually imported into this country from the Baltic, the Levant, the Barbary Coast, and North America. In some parts of Europe and America wax is very extensively employed in the religious ceremonies of the inhabitants. Humboldt informs us that upwards of 80,000 pounds worth is annually imported from Cuba to New Spain, and that the total export from that island in 1803 was worth upwards of 130,000*l*. By far the greater part of this wax is the produce of the hive-bee, though no inconsiderable quantity is procured also from various species of wild bees, as well as from certain trees which I shall notice presently.

Upon this subject a modern writer, after lamenting the increasing neglect of bee-culture in this country, has not hesitated to use the following contemptuous, though somewhat extravagant,

language. "There is hardly bees-wax enough produced in England to answer the demand for lip-salve alone; but importation from America supplies all our wants, for the quantity obtained in that country is annually increasing." "Little thinks the ball-room beauty, when the tapers are almost burnt out, that the wax by whose light her charms have been exalted was once hidden in the bells and cups of innumerable flowers, shedding perfume over the silent valleys of the Susquehanna, or nodding at their own reflected colours in the waters of the Potomac and Delaware."

The uses of wax in making candles, ointments, &c. are well known.

According to Buffon, the bees-wax of tropical climates is too soft for any but medicinal purposes.

There is a species of *wax*, which is generally regarded as *of vegetable origin*, and which is afforded by various trees, plants and fruits. The light down which silvers over the surface of prunes and other stone fruits, has been shown by M. Proust to be wax, the leaves and stem of the *Ceroxylon* also, afford it in considerable quantity, if bruised and boiled in water; but the trees which afford it in greatest abundance, are the *Myrica cerifera angustifolia* or wax tree of Louisiana, and the *Myrica cerifera latifolia* of Pennsylvania, Carolina, and Virginia. The latter is now naturalized in France: it flourishes also in the dry lands of Prussia, and,

from the productiveness of its berries, it seems surprising that its culture is not more general.

The mode in which this *myrtle wax* is obtained is as follows. Towards the end of autumn the natives gather the ripe berries, boil them in water, skim off the wax which rises, strain it off from its impurities, and set it to drain, after which, they remelt and form it into masses. Four pounds of berries yield about one pound of wax.

From the wax thus procured, they make soap and candles. The soap manufactured from it is said to be excellent, and to wash linen perfectly white; the candles afford a good light, without smoke or guttering; their perfume is highly agreeable, not only during the time that they are burning, but for a considerable time afterwards.

Mr. Sparrman suspects that myrtle wax is deposited upon the berries by insects, and Du Valde has given an account of a white wax made by small insects, round the branches of a tree in China, in great quantity, which is there collected for medical and economical purposes. (Description of China, vol. i. page 230.) Myrtle-wax therefore may not be a vegetable product.

According to the experiments of M. Cadet and Dr. Bostock, this *myrtle wax differs in some respects from bees-wax*. It differs from it in colour, different specimens of it assuming different shades of yellowish green: its smell is also different;

myrtle wax, when fresh, emitting a fragrant balsamic odour. It has in part the tenacity without the unctuousity of bees-wax, and somewhat of the brittleness of resin. Its specific gravity is greater, insomuch that it sinks in water, whereas bees-wax floats upon it ; and it is not so easily bleached to form white wax.

*Analysis of Wax.*

Carbon . . . . . 81,79

Oxygen . . . . . 5,54

Hydrogen . . . . . 12,67

“The formation of resin and wax has been explained thus:—That when a volatile or a fixed oil is expelled out of plants, and has its surface exposed to the air, the first becomes a resin by losing hydrogen, the second a wax by absorbing oxygen.”—Parkes’s Chemical Catechism, p. 244, 11th edit.

## CHAPTER XXIX.

## HONEY.

HONEY is a well known, sweet, tenacious, substance, which in fine weather is continually secreting in the nectarics of flowers, chiefly from certain vesicles or glands situated near the basis of every petal, from whence it is collected by bees and other insects. The domestic honey bees consume a portion of this honey for food, at or near the time of gathering ; but the principal part is regurgitated and poured into the cells of the hive, for the use of the community in winter:—so very abundant are these collections, in favourable seasons, as to afford to the apiarian an extensive share of them, without distressing the provident hoarders. Mr. Wildman states that in the year 1789, he purchased a glass filled with exceedingly fine honey-combs, weighing 63lbs., which had been collected within a month, and that the hive which it had surmounted still contained a full supply for the winter's consumption of the bees. This however was an unusual quantity ; a hive or box, of the dimensions recommended in this work, may be considered as well stocked when it yields from 30 to 40lbs. of honey.

The honey intended for early use, and for the

nursing bees and drones, is deposited in cells which are allowed to remain open, and is probably of an inferior sort ; whilst the finest honey, which is laid up in store for winter, is placed in the most inaccessible parts of the hive, and closed in the cells with waxen lids.

“ There cluster’d now clear wells of nectar glow,  
Like amber drops that sparkle in the Po,  
And now (so quick the change) ere one short moon  
Shrinks with waned crescent mid the blaze of noon,  
All veil’d from view, these amber drops are lost,  
And each clear well with waxen crown embost.”

EVANS.

In the Philosophical Transactions for 1792, Mr. Hunter has stated, that whatever time the contents of the honey bags may be retained, they still remain pure and unaltered by the digestive process. Mr. Polhill, a gentleman to whom the public are indebted for several articles in Rees’s Cyclopædia appertaining to bees, is also of this opinion. Messrs. Kirby and Spence do not admit this statement : as the nectar of flowers is not of so thick a consistence as honey, they think *it must undergo some change in the stomach of the bee*. This opinion is strengthened by what has been stated by Reaumur : he observed that if there was a deficiency of flowers, at the season of honey-gathering, and the bees were furnished with sugar, they filled their cells with honey, differing in no other respect from honey collected in the usual

way, but in its possessing a somewhat higher flavour. The same may be observed when they imbibe the juices of sweet fruits, for bees do not confine themselves solely to flowers and honey-dewed leaves ; they will sometimes very greedily absorb the juice of raspberries for instance, and thus spoil them for the table ; they also visit in crowds the vats of the cider and wine maker.

Reaumur has likewise remarked, that *in each honey-cell there is a cream-like layer or covering, of a thicker consistence than the honey itself*, which apparently serves to retain the more liquid collections that may from time to time be introduced under it. Messrs. Kirby and Spence say, that if honey were the unaltered nectar of flowers, it would be difficult to conceive how this cream could be collected in proper proportions. This observation is made, in consequence of their presuming that some of this cream-like covering is conveyed into the cells with each deposition of fresh honey ; and it has been supposed that this cream was the last portion disgorged. According to an article in Rees's Cyclopædia, probably written by Mr. Polhill, this cream-like matter is formed at the very first, and every addition of honey is deposited beneath it. The bee, entering into the cell as deeply as possible, puts forward its anterior pair of legs, and with them pierces a hole through the crust or cream : while this hole is kept open

by the feet, the bee disgorges the honey in large drops from its mouth ; these, falling into the hole, mix with the mass below : the bee, before it flies off, new-models the crust, and closes up the hole. This mode of proceeding is regularly adopted by every bee that contributes to the general store.

The power of *regurgitation* in the bee is very remarkable : its alimentary organs, like those of the pigeon, besides being subservient to the purpose of nutriment, afford it a temporary store-room or reservoir. Ruminating animals may be considered as regurgitating animals, though in them the operation is performed for different purposes. In some it is exercised for the purpose of digesting the food, in others for feeding the young ; but in bees its use is to enable them to disburden themselves of the honey which they gather for the winter's store of the community.

*The finest flavoured and most delicate honey* is that which *is collected from aromatic plants*, and has been stored in clean new cells : it has been usually called *virgin-honey*, as though it were elaborated by a fresh swarm of bees ; but this is not essential to the perfection of honey, for, provided the cells in which it is deposited have never contained either brood or farina, it is not material whether it have been collected by swarms or by old stocks ; the season and the flowers having been the same, the quality of the honey

will in both cases be alike. F. Lamberti asserts, that the best honey in the world is produced in Pontus, and that its superiority is attributable to the great quantity of balm growing there. In this quarter of the world, the *Narbonne honey* is regarded as the finest, owing to the rosemary which abounds in the neighbourhood of Narbonne. "The honey, for which *Narbonne* is so deservedly celebrated, is every year diminishing. Bees have ceased to be an object of attention to the peasantry; they now devote their time to the vineyards, and neglect the bees. The flowers of the wild plants, in the neighbourhood of Narbonne, are highly aromatic, and give the flavour which is peculiar to its honey: this peculiarity is attributed exclusively to the wild rosemary, *Rosmarinus officinalis*." (Duppa's Miscellaneous Observations and Opinions on the Continent. 1825.) Attempts are said to have been made to imitate Narbonne honey, by adding to other honey an infusion of rosemary flowers.

Of the power which some flowers possess of imparting deleterious qualities to their honey, I have already spoken in the chapter on Pasturage. I will here add, however, what has been said of the appearance of this *pernicious* kind of *honey*. "It is usually distinguished from what is innocent, by its crimson or reddish brown colour, its bitter flavour, and thicker consistence; but in Florida

and Carolina it is so similar, in all respects, to innocent honey, that the hunters depend upon experience only, and, knowing that bad honey soon shows its effects, they at first eat very sparingly. The converse of this would appear in the "blood-red honey" found by Mr. Bruce at Dixan in Abyssinia, to which he ascribes no evil properties. (Travels to the Nile, vol. v.) Linnæus informs us, that in Sweden, the honey of autumn is principally gathered from the flowers of the *Erica* or Heath, and that it has a reddish cast. The honey of our native heaths is also of the same colour. Dr. Barton has observed that during his residence at Edinburgh, the Highland honey was often of a dirty brownish colour, which was supposed to be given to it by the "blooming hather," as Burns calls it: the people of Edinburgh, however, though great consumers of it, never complain of any ill effects from it. It produced upon the Doctor a soporific effect. The most innocent honey will often disagree with those who take it in large quantities, or who have irritable bowels; usually, in such cases, it produces purging, and sometimes griping pain. The mischievous qualities of honey have been said to be destroyed by boiling and straining, or even by long keeping only; yet when made into metheglin, it has been found as deleterious as ever.

*The quality of honey varies with the time of*

*gathering*, and that even though the whole season may have been favourable. The collection at the commencement of summer is regarded as the prime honey of the year, the flowers being then most abundant, and in the full glow of health; and that which is collected in spring is superior to the gleanings of autumn.

Huber states that *the secretion of honey and the formation of wax are singularly promoted by electricity*: hence the works may always be observed to advance rapidly when there is a southerly wind, a moist warm air, and an impending storm; whereas the secretion is impeded, and sometimes suspended, by long protracted droughts, cold rains, and a northerly wind.

*Prime honey* is of a whitish colour, an agreeable smell, a pleasant taste, and a thick consistence. When taken from the combs it is in a fluid state, but gradually thickens by age, and in cold weather, if genuine, it becomes firm and solid. In England, it has seldom, if ever, been known to assume this solid state while in the hives; and even out of them, if it remain in the combs, it will preserve its clearness, purity and fine flavour, for at least a year. The honey of tropical climates is always in a fluid state. *Vide* chapter on Exotic Bees.

*Much of the fine flavour of honey will depend upon the manner of its separation from the comb.* That will be the most delicate which flows spon-

taneously from the purest and whitest combs ; the next in excellence will be that which is expressed without heat ; and the coarsest, that which is obtained by the aid of heat and pressure.

Care should be taken in the selection of *the vessels used for storing honey* ; the most appropriate are *jars of stone ware*, called Bristol ware. The principal constituents of *sugar and honey* are the same ; viz. hydrogen, carbon, and oxygen. Besides these their common elements, honey contains mucilage and extractive matter, and also an excess of oxygen : in plain English, honey possesses a greater proportion of acid than is contained in sugar, and in a state more capable of acting upon those bodies with which it comes in contact. From this the reader will perceive my reason for recommending stone jars for its preservation : the acid of the honey acting upon the lead with which every other kind of earthen ware is glazed, causes the honey to receive an impregnation from it, which may prove injurious to those whose constitutions are delicate : the stone ware, being glazed with common salt, cannot communicate any injurious property to the honey which is stored in it. *Honey should be kept in a cool and dry situation*, as warmth promotes fermentation and generates a sensible acidity. The circumstance of honey, when separated from the combs and put into jars, being disposed to ferment in a temperature much

below the usual heat of a hive, is calculated to excite our admiration of the instinctive intelligence of the bee, which leads it to distribute its treasure in small cells and to seal them closely over, whereby the honey can be preserved from fermentation for a long period, even in a high temperature. PROUST says that *granulated honey is capable of being separated into two parts, one of which is liquid, the other dry and not deliquescent, crystallizable in its manner and less saccharine than sugar. The Jews of Moldavia and the Ukraine prepare from honey a sort of sugar which is solid and as white as snow, which they send to the distilleries at Dantzic. They expose the honey to frost for three weeks, in some place where neither sun nor snow can reach it, and in a vessel which is a bad conductor of caloric, by which process the honey, without being congealed, becomes clear and hard like sugar.*

Prior to the discovery of sugar, honey must have been an article of great utility; and notwithstanding that discovery, if we may judge from the quantity imported into this country, and the price at which it sells when of fine quality, it may still be regarded as a commodity of great importance, and worthy of more attention from our rural population than it in general obtains. *In the Ukraine, some of the peasants have four or five hundred hives each, and find their bees more profi-*

*table than their corn.* This is a number however which I should think would overstock most districts, and which could only be supported naturally by having recourse to transportation. This seems to be evinced by the inhabitants of Egypt, France, Savoy, Piedmont and other places availing themselves of that practice, as already stated.

The most productive parts of this kingdom, in all probability, are the borders of Cambridgeshire, Hertfordshire, and part of Hampshire, which abounding in heaths, commons and woods, afford so much pabulum for bees, as to enable some of the farmers to have from 100 to 150 stocks of them, the largest number that I have ever heard of in this kingdom.

On the subject of *overstocking*, Mr. Espinasse says that few parts of England which he has visited afford flowers in sufficient profusion and of sufficient variety to support numerous colonies. "In the village," says he, "where my house is situated, many persons, induced by my example, procured bees; they were too numerous for what was to feed them; more than one half of them died in the ensuing winter, and nearly one third of my own were with difficulty saved by feeding." The proprietor of bees may know whether or not his situation is overstocked, if he will attend to the produce of his apiary for several years together.

## CHAPTER XXX.

## MEAD.

PRIOR to the introduction of agriculture into Britain, mead was the principal cordial beverage of its inhabitants. In other northern nations also it was formerly in high estimation. This must have proceeded, either from their unpampered simplicity of taste, or from their having a better method of making their mead than has been handed down to posterity; for certainly in the present day it is a liquor seldom heard of, and still seldomer made; and when made, holding a very humble rank among our imperfect vinous productions. It however continued in favour long after the introduction of malt liquor, and the northern inhabitants of Europe drank it generally until very modern times. To show how highly it was formerly esteemed in this country, I will give an extract from an ancient law of the principality of Wales, where “the praises of it, accompanied by the lyre, resounded through the spacious halls of her princes.” “There are three things in Court which must be communicated to the king, before they are made known to any other person.

- “1st, Every sentence of the judge ;  
2nd, Every new song ; and  
3rd, Every cask of Mead.”

Mead-making appears to have been regarded by our forefathers as a high and important avocation ; at the courts of the Princes of Wales, the mead-maker was the eleventh person in dignity, and took place of the physician. We read in the English History, that Ethelstan a subordinate king of Kent, in the tenth century, on paying a visit to his relation Eihelfleda felt very much delighted that there was no deficiency of mead. According to the custom at royal feasts, it was served up in cut horns and other vessels of various sizes. About the same period, it was customary to allow the monks a sextareum (about a pint) of mead between six of them at dinner, and half the quantity at supper.

It was probably the liquor called by Ossian, the joy and strength of shells, with which his heroes were so much delighted ; the Caledonian drinking-vessels having consisted of large shells, which are still used by their posterity in some parts of the Highlands. Mention is sometimes made also of the Feast of Shells.

Mead was the ideal nectar of the Scandinavian nations, which they expected to quaff in heaven out of the skulls of their enemies ; and, as may reasonably be supposed, the liquor which they exalted

thus highly in their *imaginary celestial banquets*, was not forgotten at those which they *really* indulged in *upon earth*. Hence may be inferred the great attention which must have been paid to the culture of the bee in those days, or there could not have been an adequate supply of honey for the production of mead, to satisfy the demand of such thirsty tribes.

The mythology of Scandinavia (the religion of our Gothic ancestors) was imparted by Sigge or Odin, a chieftain who migrated from Scythia with the whole of his tribe, and subdued either by arms or arts the northern parts of Europe. From him descended Alaric and Attila. In the singular paradise which Odin sketched for his followers, the principal pleasure was to be derived from war and carnage ; after the daily enjoyment of which, they were to sit down to a feast of boar's flesh and mead. The mead was to be handed to them in the skulls of their enemies, by virgins somewhat resembling the *houri* of the Mahometan paradise, and plentiful draughts were to be taken, until intoxication should crown their felicity. Hence the poet PENROSE thus commences his "Carousal of Odin."

" Fill the honey'd bev'rage high,  
Fill the skulls, 'tis Odin's cry !  
Heard ye not the powerful call,  
Thundering through the vaulted hall ?

Fill the meath and spread the board,  
Vassals of the grisly lord !—  
The feast begins, the skull goes round  
Laughter shouts—the shouts resound !”

Hence likewise, in an ode by Mr. STIRLING, we find the following illustration of the northern Elysium.

“ Their banquet is the mighty chine  
Exhaustless, the stupendous boar ;  
Virgins of immortal line  
Present the goblet foaming o’er :  
Of heroes’ skulls the goblet made,  
With figur’d deaths and snakes of gold inlaid.”

Boar’s flesh was considered by these tribes as the highest delicacy ; the celestial boar was supposed to be daily renewed, and to afford an ample repast for the most numerous party : a quantity of mead also, sufficient for the intoxication of this paradisiacal community, was imagined to be daily supplied by a goat called Heidruna,

“ Whose spacious horn would fill the bowl  
That rais’d to rapture Odin’s soul ;  
And ever drinking, ever dry—  
Still the copious stream supply.” COTTLE.

I could not refrain from adducing these short historical and poetical evidences of the high estimation in which mead was held by our northern ancestors. I trust that I shall also stand excused for still further lengthening my preamble by en-

tering upon *the general principles of wine-making.*

*The grand desiderata in wine are strength, flavour, and pleasantness :—*to accomplish the first, sugar must be converted by fermentation into alcohol ; the second depends upon the article to be vinified, and upon the management of the process of vinification ; flavour may likewise be produced artificially by different adjuncts : pleasantness will principally result from the same causes, but more especially from the liquor holding in solution a certain quantity of unconverted sugar.

*The elements necessary to a due fermentation* and to bring the process to a satisfactory issue, *are sugar, extractive matter, acid of tartar, and water.* These exist in the highest perfection and in the best relative proportions in *the grape* : hence the superiority of foreign wines. Whoever therefore expects to imitate, with much effect, those generous liquors, must supply in the process those ingredients in which the article sought to be converted into wine is deficient.

If the native juices of fruits be deficient in sugar, it will be impossible to convert them into a strong wine without a proper supply of that ingredient ; and without a sufficiency of extractive matter, which is the natural ferment, a due fermentation could not be established ; the wine would be sweet, but not potent ; *sweet wines being the produce of*

*an incomplete fermentation.* If the extractive matter were in excess, the liquor would have a tendency to the acetous fermentation, which might also be induced by a superabundant proportion of water.

*The result of a complete fermentation is a dry wine ;* to produce which, the elements must all be nicely balanced, and the process conducted under favourable circumstances, with respect to temperature, tunning, stopping down, &c.

Two opposite practices prevail, in the manufacture of the same sort of wine ; *some wine-makers boiling the juices before fermentation, others conducting the whole process without boiling :* the propriety or impropriety of these practices depends upon the quality of the juices to be vinified. Extractive matter is partially coagulable by heat ; boiling therefore, by causing this matter to separate and to be deposited, tends to the production of a sweet wine. The extractive matter may also be precipitated by sulphuric acid gas, (burning in the cask a brimstone match as hereafter directed,) or by sulphuric acid itself, with which the soluble leaven forms an insoluble compound. Hence where the extractive matter is in excess, and where there is danger of fermentation going on too rapidly, boiling or sulphuring will be useful both to the wine and cider-maker, in checking or preventing fermentation. The superfluous ex-

tract thrown up in the course of fermentation as yeast, or deposited as lees, will, if remixed with the liquor, have the effect of continuing the fermentation : hence the utility of racking and fining, where it is in excess ; and of re-union, where it is deficient. *Artificial leaven or yeast*, which contains the extractive principle in great abundance, affords a supply to those juices which are deficient in it, and without which they will not ferment. *Natural leaven* (i. e. *extractive matter*) is soluble in cold water, artificial leaven is not : during fermentation, therefore, the latter is always thrown off ; so also is the greater part of the former, if the process be well conducted.

Most of the fruits of this country abound in *malic acid* ; those that possess only a moderate quantity of it, however, afford excellent wine with the addition of sugar only ; still better wine may be obtained by the further addition of the acid of tartar. Where the malic acid prevails so abundantly as to make its neutralization desirable, DR. McCULLOCH, (to whom I am indebted for much of the information contained in this chapter,) recommends the coating of the insides of the fermenting vats with a white wash of hot *caustic lime*. I have neutralized the malic acid, by putting into the cask, after the sensible fermentation has been completed, about a pound of *egg shells* to every sixty gallons of wine.

The acid of tartar increases the fermenting power of fluids: half-ripe fruits possess it in greatest abundance; hence the vivacity of champagne and green gooseberry wine. It is most conveniently used in the state of supertartrate of potash or common cream of tartar: the common rough tartar is in some respects preferable, as its admixture of yeast assists in perfecting the fermentation.

All vegetables contain more or less of extractive matter; those that possess little may be assisted in their fermentation, by that process being conducted in wooden vessels, wood supplying the extractive principle to the liquor; the same juices therefore which would ferment very well in wood, would scarcely ferment at all in glass or earthenware.

The extractive matter and the sugar are seldom completely destroyed in any wines; the existence of the former is evinced, by the skinny matter frequently deposited upon the insides of the wine-bottles; the latter may be detected, by a nice palate, in the very driest of our wines; its predominance indicates an inferior wine.

From the preceding observations, my readers have probably anticipated my opinion of *honey*, in wine-making. I regard it merely as a *substitute for sugar*; and to those who approve of its flavour I recommend the following *directions*, which I

have successfully followed for several years, having my home-made wines enriched with a considerable portion of foreign flavour.—Dissolve an ounce of cream of tartar in five gallons of boiling water ; pour the solution off clear upon twenty pounds of fine honey, boil them together and remove the scum as it rises. Towards the end of the boiling, add an ounce of fine hops ; about ten minutes afterwards, put the liquor into a tub to cool ; when reduced to the temperature of about 60° Fahrenheit, add a slice of bread toasted and smeared over with a very little yeast ; the smaller the quantity the better, for *yeast invariably spoils the flavour of wines*, and where there is a sufficiency of extractive matter in the ingredients employed, it should never be introduced. The liquor should now stand, and be stirred occasionally, till it carries a head, when it should be tunned and the cask filled up from time to time from the reserve, till the fermentation has nearly subsided. It should now be bunged down, leaving open a small peg-hole ; in a few days this may also be closed, and in about twelve months the wine will be fit to bottle.

Many makers of both wine and cider have been unconsciously benefited from the acquisition of tartar by their liquor ; it being a frequent practice to tun into an empty foreign wine cask, whose incrustated sides have supplied their wine or their

cider with a portion of that necessary ingredient for perfect vinification.

It is a practice with some to add *spices* to their Mead during the fermentation, such as ginger, cloves, mace, rosemary, lemon-peel, &c. This is bad œconomy; a much smaller quantity will communicate the required flavour if the addition be made after the fermentation has ceased.

A *common beverage* is sometimes made, by simply boiling the refuse honey-combs in water after extracting from them as much of the honey as will run; this liquor will not require tartar or yeast: it should be tunned as soon as cool, bunged down in three or four days, and drank in a few weeks. In some parts of Wales the refuse combs are brewed with malt, spices, &c. and the produce is called *Braggot*, a name derived from the old British words *brag* and *gots*, the former signifying *malt*, the latter *honey-comb*.

A knowledge of the principles of fermentation will enable the wine-maker to regulate its process. Thus if a dry wine be desired, and fermentation be suspended, it may be renewed by a restoration of the separated leaven or the addition of fresh; or by agitation and a remixture of the lees. It is upon the latter principle, called "*feeding on the lees*," that some foreign wines are improved by long voyages; but this treatment, so *serviceable*

*to Madeira and other Spanish wines, and also to some of the French wines, would destroy Burgundy.* If there be an excess of fermentation the scientific operator will regulate, check or suspend it, by skimming, racking, fining. If skimming and racking do not succeed, recourse must be had to *fining*, which may be effected by *isinglass*, in the proportion of about an ounce to 100 gallons. The isinglass must be beaten, for a few days, with a whisk in a small quantity of the wine, till completely attenuated. This solution must then be well stirred into the cask of wine, which in about a week will become fine and fit for being racked off. This fining is accomplished by the union of the isinglass with what is called the tannin of the wine. Fining may also be effected by *stunning*, i. e. *by burning in a close vessel containing a small part of the wine a brimstone rag*, at the rate of a dram of sulphur to thirty gallons; and when consumed, rolling the cask about for a quarter of an hour, that the wine may absorb as much as possible of the sulphuric acid gas. This being done, the cask is to be filled up with the remainder of the wine, and bunged down. In this process the sulphuric acid or its oxygen unites with the extractive matter or soluble leaven, which being thereby rendered insoluble is precipitated to the bottom, as I before observed. If wines be per-

fectly fermented, they do not require the addition of any brandy, as a sufficiency of spirit is generated during the process.

*The best temperature for carrying on fermentation* is about 54° Fahrenheit. Its perfection depends in some degree upon the volume of the liquor; the larger the quantity, the longer the fermentation will continue, and the stronger and pleasanter will be the wine. There are however exceptions to this rule. The peculiar excellence of champagne would be destroyed, if its fermentation were conducted upon a large scale: it may be made successfully in a gallon measure. This wine is so managed by the makers as to ferment after bottling.

*Dry wines and fine wines* are much more durable than any others; and those that would perish in cask, *may be preserved many years by bottling.*

These hints will, I hope, enable the makers of home-made wines to conduct the process scientifically, and to secure generally a successful issue. Cookery books and good housewives abound in receipts for wine-making, which are very often fanciful and absurd, recommending the introduction of articles which, in their very natures, counteract the production of good wine. Hence we are sometimes presented with such miserable mawkish stuff, as disgraces the name of wine,

being only rendered tolerable by the brandy which has been added to it, and which in some degree covers the crudeness and insipidity of the compound, and moderates its hostility to the peace of our stomachs.

THE  
ANATOMY AND PHYSIOLOGY  
OF  
THE BEE.

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PART II.

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CHAPTER XXXI.

ANATOMY.

HAVING given in detail the instructions necessary for the domestic management of the Bee, and treated of such parts of its physiology as that detail naturally suggested; I shall now proceed to give an account of the most important parts of its anatomical structure, and so much more of its physiology as may arise from a consideration of that structure, or be otherwise likely to interest my readers.

Some persons may possibly consider a description of the anatomy of so small a creature as

unimportant and uninteresting; but without understanding the anatomy of the bee, its physiology would be vague, uncertain, and conjectural; and it is physiological knowledge that has hitherto led, and must still lead, to a scientific and profitable management of this insect. The enlightened BOYLE, when contemplating the various wonders of Nature, has declared his astonishment to have been more excited by the mite than by the elephant; and that his admiration dwelt, not so much on the *clocks* as on the *watches of creation*. It is not my intention, however, to enter deeply into the anatomy of the bee, but merely to give a general account of those parts which are most prominent and important; anything beyond this would, to the general reader, be tedious and uninteresting. Those who desire minute information may obtain it in various works, but in none more satisfactorily than in that of MESSRS. KIRBY and SPENCE.

The natural divisions of the Bee	}	are	{	The Head. The Trunk. The Abdomen.
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These are connected together by ligaments.

The HEAD, in common with that of other creatures, is the inlet for nutrition and the principal seat of the organs of sensation.—Of nutrition and sensation I shall speak in their appropriate places.

The TRUNK is the intermediate section of the

body between the head and the abdomen: it approaches in figure to a sphere, and is the seat of the organs of motion; it contains the muscles of the wings and legs which proceed from it, and is the main prop, or as it were the key-stone, of the other two sections. The upper side is called *thorax* or the *chest*, the under side *pectus* or the *breast*.

The ABDOMEN is the third section of the body, posterior to the trunk; it is divided into six rings or segments, which, by sliding one over another, serve to shorten or lengthen the body. It is the seat of the organs of generation, and principally of those connected with respiration; and contains also the anus and the sting. The upper part is called *tergum* or the *back*, the under side *venter* or the *belly*.

#### THE HEAD.

The most remarkable part of the head is the PROBOSCIS, of which so good an account has been given by DR. EVANS that I shall describe it nearly in his words.

It is not so much the mere simplicity of nature, which excites our wonder and admiration, as that apparently complex structure, which operates with all the ease of the simplest machinery. Of this we have not a more striking instance than in the proboscis of the labouring bee: though the component parts of the proboscis are scarcely discernible by the naked eye, yet are they far more

complicated than the elephant's stupendous trunk. It consists of no less than five distinct branches ; namely, a central trunk, or tongue, and four horny scales, tapering to a point, convex outwards and concave towards the trunk ; the two outer ones so sheath the inner as to appear but one single tube : by a joint in the middle they bend, or extend all at once, carrying with them the unarticulated tongue, which is cylindrical, and about the size of a man's hair, and appears through a magnifier to be composed of successive rings. It has probably as many short muscles as the tongue of a fish, which are capable of moving it in all directions ; and towards its termination is furnished with hairs or villi, some of which at the point are very long, and seem to act like capillary tubes. MR. WILDMAN assures us, that he has seen the trunk growing bigger and less by turns, swelling the instant the bee sucked ; and this alternate lessening and enlargement propagated from the extremity to the root. What a delicate apparatus of invisible muscles must perform this office ! The tongue is capable of being contracted and folded up at pleasure ; for if it were constantly extended, it would be exposed to injury : when at rest, therefore, it is doubled up by means of its joint, and lies in a very small compass ; the first portion being brought within the lip, and the second part folded under the head and neck, protection is given to it by a double

sheath, consisting of four strong scales, the two inner scales sheathing the tongue, and the two outer and larger ones encompassing the whole. When at work, the trunk is lengthened beyond its sheaths, probes the very bottom of the flowers, through all impediments of foliage or fructification, and drains them of those treasured sweets which, without such an apparatus, would be completely inaccessible.

The proboscis of the bee is not used like that of other flies, not being tubular like theirs, but serves as a brush or besom to sweep, or as a tongue to lap\*; having collected the nectar of flowers in small drops, it deposits its collection upon the tongue, which is protruded for the purpose of receiving it, and having received it, withdrawn again.

The LIPS. The bee has two lips, an upper one called *labrum*, and an under one called *labium*; (the *Mentum* of Latreille.)

The TONGUE of the bee, which is very long, is at its upper part cartilaginous; below the middle, membranous and capable of considerable inflation, thus forming a bag to receive the honey from the proboscis, preparatory to its conveyance into the pharynx. It terminates in a knob, but has no

\* The bee and all other insects that lap their food are called lambent insects.

passage through it, to exercise the power of suction, as has been supposed. When in a state of inaction, it is folded up longitudinally, and lies between the lips. The tongue of the working bee is probably the largest of any known animal, for its size ; it is much longer than that of either the male or queen, and thus fitted for taking up honey at a considerable depth. The bee has the power of unfolding it with great rapidity, and darting it betwixt the petals and stamina of those flowers that afford honey, it moves it about in every direction, sweeping the convex as well as the concave surface of the petals.

The PHARYNX lies at the root of the tongue ; it is an opening by which the honey passes from the tongue to the gullet or honey-bag, and closes by a valve.

The ŒSOPHAGUS or GULLET receives the food from the pharynx, and conveys it, in part at least, to the stomach, there to be digested, animalized, and forwarded to the small intestines, from whence it is distributed, through appropriate vessels or tubes, to all parts of the body for its nutriment. The gullet is long and slender, commences at the termination of the pharynx, and traversing the neck and breast, dilates into a fine bag, transparent as crystal, and when filled with honey about the size of a small pea. In bees caught on going out early in the morning, Mr. Hunter found this re-

servoir perfectly empty ; but in those returning from the fields, it was quite full of honey, *some* of which had passed into the stomach.

The MANDIBLES or upper jaws move horizontally, and are armed with teeth.

The MAXILLÆ or under jaws are situated below the mandibles, have a similar motion, and form, according to Linnæus, the sheath of the tongue. De Geer regarded them as part of the apparatus of the under lip, on each side of which they are placed.

The mandibles are powerful organs, hard and horny, and constitute the tools with which the bee performs its various labours ; the maxillæ on the contrary are soft and leathery : the latter probably serve to hold such materials as the former have occasion to operate upon.

The ANTENNÆ. Of all the organs of insects, none appear to be of more importance than their antennæ : in all the tribe they are planted either between or below the eyes ; and no insect has more than two : in their general structure, they consist of a number of tubular joints, each having a separate motion, which gives them every variety of flexure. The antennæ of the male have one more joint than those of the female, the former having thirteen, the latter only twelve. They seem to enable the insects, by certain signs and gestures, to communicate to each other their

mutual wants or discoveries. But I shall enter more fully into this subject when I come to speak of the various uses to which the antennæ are applied.

The PALPI or FEELERS are also important organs; their ends are furnished with nervous papillæ, indicating some peculiar sense, of which they are the instrument: they are four in number, two emerging from the maxillæ called maxillary feelers, and one from each side of the labium, called labial feelers. The maxillary are short and without a joint, the labial long and with four joints, including the two flat joints or elevators.

The EYES, two in number, are placed in the sides of the head; they are compounds of an infinite number of hexagonal lenses, as clear as crystal, and are guarded by a horny tunicle or covering. This subject is however treated of in Chap. XXXII.

### THE TRUNK.

The trunk affords attachment to the organs of motion.

First, To the WINGS, which transport the insect through the air; these consist of two *superior* and two *inferior*: they are membranous and transparent, and while in a state of repose are incumbent on each other, covering the abdomen.

Bees and various other hymenopterous insects,

and also those of the dipterous family, possess the power of flying in a more perfect degree than any class of animals besides, surpassing in this respect even the bird tribe. In the anterior margin of the under wings small hooks (*hamuli*) are placed, which are capable of laying hold of the posterior margin of the upper wings, by means of which they are kept steady when flying. These hooks are discoverable under a good magnifier.

Secondly, To the LEGS, by which the insect moves itself from place to place upon the earth. Of these there are *six in number*, each composed of several joints, and articulated like our arms, thus affording the power of various movements: in the legs are three distinct divisions; namely, the thigh, the shank, and the foot. In the *four* hinder legs one joint forms a kind of *brush*; externally smooth and bare, but covered on the inside with stiff bristling hairs. By these the insect is enabled to brush off farina both from the tips of the stamina of flowers and from the hairs of its own body. With the jaws and two fore-feet, the meal is rolled into small compact masses, which are conveyed, by the middle pair of legs, to the *spoon-shaped cavities* in the centre joint of the two hindmost feet; these are surrounded by strong close set hairs, to secure more firmly the precious burdens. (No such groove is to be found in the legs of either the queen-bee or drone.) *Each foot ter*

minates in *two hooks*, with their points opposite to each other, by means of which the bees suspend themselves from the roofs or sides of the hives or boxes, and hang from each other, in the form of festoons, ropes, or cones. From the middle of each pair of hooks proceeds a little thin *appendix*, which is usually folded up; when unfolded it enables the insects to fasten themselves to polished surfaces, such as glass, &c.: they probably also use it for taking up small bodies, the pollen for instance, which they thereby transmit to the hollows of their hinder legs.

The trunk also gives origin to a number of muscles, serving various purposes, which it would lead me too much into detail to enter upon here.

#### THE ABDOMEN.

The *abdomen*, besides various other parts, contains the *honey-bag*, the *venom-bag*, and the *anus*, which latter in the female comprehends the *ovipositor* and *sting*: in the male it contains the *organs of reproduction* but no sting, and of course no ovipositor. For a particular account of these, *vide* Organs of Reproduction further on.

#### ORGANS OF SENSATION.

We have an abundance of presumptive evidence that bees are endowed with *sensation* and *perception*, and that the excitement of these faculties is

communicated, through the medium of *nerves*, to a common *sensorium*, though the latter was denied to insects by Linnæus and other eminent naturalists. Common sensation, however, does not reside in the brain alone of insects, as in that of warm-blooded animals, but in the spinal marrow also ; hence it is that bees and many other insects exhibit signs of sensation after their heads have been severed from their bodies. Some insects exhibit these for a long time afterwards, the wasp for instance ; LYONNET informs us that he has seen motion in the body of a wasp, three days after its division from the head ; and I have known several instances of its inflicting wounds with its sting, at least four-and-twenty hours after the separation. The severed body will not only move but walk, and sometimes even fly, at first almost as actively without the head as with it. The penetrating genius of LORD BACON afforded him such illumination upon this subject, as to enable him to approach very near to what is at this day regarded as a correct statement of the cause of this *protracted vitality* in mutilated insects. “They stirre,” says he, “a good while after their heads are off, or that they be cut in pieces ; which is caused also for that their vital spirits are more diffused throughout all their parts, and lesse confined to organs than in perfect creatures.”

That insects have a real sensorium or brain,

would seem to be proved by their having *memory*, and a *capacity to receive instruction*, and *acquire new habits*. Such functions in higher animals are regarded as functions of a cerebral system. That they are endowed with memory cannot well be doubted. HUBER relates a remarkable instance of it in bees, which illustrates what will hereafter be said on their having a method of communicating information to each other. "Honey," says he, "had been placed in a window in autumn, where the bees resorted to it in multitudes. It was removed, and the shutters closed during winter; but when opened again, on the return of spring, the bees came back, though no honey was there. Undoubtedly they remembered it, therefore an interval of several weeks did not obliterate the impression they had received." "But the most striking fact evincing the memory of bees has been communicated to me," says MR. KIRBY, "by my intelligent friend MR. W. STICKNEY, of *Ridgemont, Holderness*. About twenty years ago, a swarm from one of this gentleman's hives took possession of an opening beneath the tiles of his house, whence, after remaining a few hours, they were dislodged and hived. For many subsequent years, when the hives descended from this stock were about to swarm, a considerable party of scouts were observed, for a few days before, to be reconnoitring about the old hole under the

tiles ; and *Mr. Stickney* is persuaded, that if suffered, they would have established themselves there. He is certain that for eight years successively the descendants of the very stock that first took possession of the hole, frequented it as above stated, and *not* those of any other swarms ; having constantly noticed them, and ascertained that they were bees from the original hive by powdering them, while about the tiles, with yellow ochre, and watching their return. And even at the present time, there are still seen every swarming season about the tiles, bees, which *Mr. Stickney* has no doubt are descendants from the original stock."

Some anecdotes of the spider prove that insects are capable of instruction. *M. PELISSON*, when he was confined in the Bastile, tamed a spider, and taught it to come for food at the sound of an instrument. *A manufacturer* also, in an apartment at *Paris*, fed 800 spiders, which became so tame, that whenever he entered it, which he usually did with a dish of flies, they immediately came down to receive their food. That insects are susceptible of a change of habits, or rather that they may acquire civilized habits, if I may say so, is shown by the domestication of bees, and occasionally by that of ants and wasps. *HUBER's* experiments, with leaf hives, show the existence of this faculty in an eminent degree, for

he assures us that it renders the bees quite tame and tractable.

Most physiologists, resting upon the evidence of analogy, agree in attributing *five senses* to insects : (DR. VIREY, as will be seen further \*on, ascribes to them *seven senses* :) though there is a difference of opinion as to the organs by which those senses are conveyed. The *antennæ*, for instance, have been regarded by some as the organs of smell, by others as the organs of touch, and by a third class as the organs of hearing. With the substitution of taste for hearing, the same opinions have been maintained respecting the *palpi* ; nor can the question even now be considered as settled. The prevailing opinion seems to be, that the antennæ are explorers or tactors, but that they are also applied to other uses ; the effects produced by their excision indicate that they are organs of the highest importance. *Vide Senses of Bees.*

MESSRS. KIRBY and SPENCE notice the analogy borne by antennæ to the ears of vertebrate animals, such as their corresponding in number and standing out from the head. No other organ has been found which can be supposed to represent the ear\*. And what I have said in another place, of their constituting a sixth sense, has received some countenance from the observations of those natu-

\* MARCEL DE SERRES thinks he has discovered an organ of hearing in most insects, but does not state its situation.

ralists. "I conceive," says Mr. K., "that the antennæ, by a peculiar structure, may collect notices from the atmosphere, receive pulses or vibrations, and communicate them to the sensorium, which, [communications] though not precisely to be called hearing, may answer the same purpose." Lehmann calls the function of the antennæ *aëroscepsy*. A very remarkable instance of the effect produced upon them by sound, is adduced by the authors just quoted, which one of them has thus related. "A little moth was reposing upon my window ; I made a quiet, not loud, but distinct noise : the nearest antenna immediately moved towards me. I repeated the noise at least a dozen times, and it was followed every time by the same motion of that organ ; till at length the insect, being alarmed, became agitated and violent in its motions. In this instance, it could not be *touch* ; since the antenna was not applied to a surface, but directed towards the quarter from which the sound came, as if to listen."

That the antennæ should have been regarded as organs of smell is not surprising when the proceedings of the bees on visiting flowers are considered ; their first act is to introduce one of the antennæ, but no further than the tip : this conduct would naturally enough convey the idea of looking or smelling for nectar ; yet it does not at all militate against the opinion that the antennæ are

transmitters of sound; the sense which they supply may, in these little creatures, be so very fine, as to enable them to hear the bursting of an anther, or the exudation of nectar. The continual motion of the antennæ of insects from side to side, when they walk, conveys the idea that it is by their means that they inform themselves of what is going on in their immediate vicinity. The importance of the antennæ may be inferred from their very complicated structure. MR. KIRBY has observed, that in one species of *Apis* which he examined, under a powerful magnifier, the ten last joints of the antennæ appeared to be composed of innumerable hexagons, and from this similarity in their structure to the eyes (*Vide Senses of Bees*) he thought that they might serve a somewhat analogous purpose.

What I have said with respect to the Senses of Bees, in another place, will I think make it evident that these insects possess an organ of smell, but with respect to its situation naturalists differ. BASTER, LEHMANN, and CUVIER, consider the spiracles as the organs of smell, as well as of respiration: this opinion is founded upon the notion that, without the inspiration of air, there can be no smell; and that as insects are smaller than the food they live upon, it would be of no consequence to them where this sense was situated. KIRBY and SPENCE, on the contrary, suppose that

it resides in some organ near the mouth : in other parts of the animal creation certainly, that is its situation ; and as there seems to be a necessary connection between smell and taste, analogy should lead us to argue in favour of that opinion ; but though smell be usually accompanied by respiratory organs, they may not be essentially necessary to it ; a bee may receive impressions from external objects, in a manner which we cannot comprehend. In confirmation of this opinion of KIRBY and SPENCE, we have the experiments of HUBER. It seems that no odour is so unpleasant to insects as that of oil of turpentine. M. HUBER having presented this oil, on the point of a camel's hair pencil, successively to every part of the abdomen, trunk and head, it excited no uneasiness in the bee : he then tried the eyes and antennæ, but with the same result ; yet as soon as he pointed it a little above the insertion of the proboscis, near the cavity of the mouth, the bee receded, became agitated, clapped its wings, and would have taken flight, had not the pencil been withdrawn. This experiment was repeated with the turpentine and other articles of penetrating odour, and with the same effect ; but when the mouths of several bees were stopped with paste, no such consequences ensued, on the contrary they traversed the impregnated pencils without being at all annoyed by them ; even honey did not attract them. All

these circumstances tend to prove that the site of smelling is in or near the mouth.—This subject will be resumed in Chap. XXXII.

### ORGANS OF RESPIRATION.

The respiration of bees is performed through several little orifices, called *stigmata*, *spiracles*, or *breathing pores*, situated in the sides of their bodies, behind their wings. REAUMUR was of opinion that inspiration was performed through the spiracles, and expiration through the mouth; but BONNET proved satisfactorily that neither inspiration nor expiration takes place through the mouth. The spiracles are connected with a system of air vessels called *tracheæ*, ramifying through every part of the frame, and serving the purpose of lungs. From the absence of lungs, ARISTOTLE and the ancients in general thought that insects did not breathe. PLINY may perhaps be excepted, for he has observed that dipping bees in honey or oil deprives them of life;—this immersion stops up the mouths of the spiracles. Modern physiologists have however incontestibly proved that they do breathe. “Life and flame,” says CUVIER, “have this in common, that neither the one nor the other can subsist without air; all living beings, from man to the most minute vegetable, perish when they are utterly deprived of that fluid.” HUBER detected the existence of the stigmata or breathing

pores, by immersing different portions of a bee in water, and finally by total immersion, upon which he observed that bubbles of air attached themselves for some time to the orifices of the stigmata, which alternately appeared and receded, till their increased bulk enabled them to overcome the resistance of inspiration and rise to the surface. These respiratory organs escaped the observation of SWAMMERDAM.

Air is equally necessary to insects in the egg state: SPALLANZANI found that their eggs could not be hatched in small close vessels, though all other circumstances were favourable to a development. The eggs of the hive-bee, whilst in the ovaries, have a net-work of air-vessels spread over their surfaces;—these were discovered by Swammerdam: from analogy, we may reasonably conclude, that such a provision obtains generally.

The closeness of a hive, and its having no direct current of air through it, may favour a belief that bees can exist in any atmosphere, however vitiated, and may seem also to confirm the opinion of the ancients, that they have no particular system of respiratory organs. But M. HUBER and SON have proved that they breathe like other animals, that they are speedily deprived of life, if the process of respiration be arrested; so delicate indeed is their organization, that they detect the smallest deterioration in the atmosphere

of their hives, and immediately adopt measures to restore to this element the degree of purity essential to respiration: from some eudiometrical experiments, it has been ascertained that the air of a well stocked hive is as pure as that by which it is surrounded. Still neither wax nor pollen favours the generation of oxygen gas, nor have bees the faculty of generating it; for when very closely shut up, they perish in a few hours. The writers just referred to, discovered that the bees, by uniting the two wings of each side, by means of the small marginal hooks with which they are provided, so as to make them present the largest possible surface to the air, were capable of striking it with considerable force, and that this force was increased by the wings forming a slight concavity. The wings arranged in this manner, are put into a violent vibratory motion by the bees appointed to the office of ventilators, and produce what we call a draught of air. *Ventilation* is thus systematically accomplished. A certain portion of ventilating bees is stationed in files at the entrance of the hive, with their heads turned inwards; another and a larger party, in files also, stands a considerable way in the interior, with their heads towards the entrance: thus both these parties cooperate, in producing a current of air in the same direction, and are so arranged as not to interrupt the passage of their fellow-citi-

zens, moving in and out. As this hard duty has no intermission during the day, nor in hot weather during the night, and must necessarily occasion fatigue, one set of ventilators is considerably relieved in about twenty-five minutes, by another set of fresh bees. Under particular circumstances the number of ventilating bees is considerably increased. "When the air," says HUBER, "was not renewed in the manner desirable, we have seen all vibrating their wings at once, though this never occurs in the natural state, when the vibrations of a few are sufficient for ventilation." Although this fanning motion of the wings is so rapid as to render them almost indistinguishable, yet they may be observed to describe an arc of  $90^{\circ}$ . The sagacious bees remind me of a method which is sometimes adopted of renewing the air of a room, called pumping; some person moves the door backward and forward so rapidly as to cause a thorough agitation of the confined air, and the introduction of a fresh unvitiated atmosphere. "When they are engaged in ventilation, the bees by means of their feet and claws, fix themselves as firmly as possible, to the place they stand upon. The first pair of legs is stretched out before; the second extended to the right and left: whilst the third, placed very near each other, are perpendicular to the abdomen, so as to give that part considerable elevation." That ventilation is carried

on for the purpose of renewing the air of the hives, and not for lowering its temperature, is evident from its being continued to a certain extent, even during the depth of winter.

The vibratory motion of the bee's wings has been regarded by some as the principal cause of the *humming* noise heard in every prosperous hive during the busy season. This humming has likewise been attributed to the rushing of the air through their spiracles: so thought M. CHABRIER, and, I believe, MR. J. HUNTER. Mr. H. assures us that bees can produce a sound independently of their wings; for if these be smeared over with honey so as to stick together, the bee still makes a noise, which is shrill and peevish. He found the same effect from holding the bee by the legs, with a pair of pincers, while the wings were perfectly still, and also by immersing the insect in water, though not till it was very much teased.

The whole body of a drone is in a state of vibration when it hums. Though deprived of its wings, it is capable of producing a sound exactly similar, and probably the same with its former hum: even when the legs are cut off, the trunk retains its tremulous motion, and utters an audible noise. If immersed in water, many air-bubbles are disengaged from it: but though the mutilated insect be taken out alive, it is no longer sonorous. "This experiment, however incomplete," says a

writer in the *Dictionnaire des Sciences Naturelles*, “tends at least to prove, that the humming of bees is not occasioned by a strong vibration of the internal part of the upper wings, but rather by a tremulous affection of the entire body; and perhaps even by the escape of a greater quantity of air through the stigmata or spiracles. This last would amount to a sort of voice.” The humming noise with which a flower is always approached by the bee, ceases as soon as she has alighted upon it, though during the time that she is extracting its sweets she is in a constant vibratory motion.

#### CIRCULATION.

The term circulation is not strictly applicable to the imperfect sanguineous system of insects, as the fluid which supplies their bodies with nutriment is not distributed to its several parts through the medium of a heart and vascular system. Lyonnet and Cuvier are both of opinion that insects have no heart, whereas all creatures that possess a circulation, properly so called, have a heart, lungs or gills, and a liver; but insects have only air-vessels and hepatic ducts. The chyle which is produced in their intestines, transpiring through the pores of the intestinal canal, passes into the general cavity of the body, where it is probably animalized, and made to answer the same purposes that blood does to creatures of a

higher class, though when animalized it still retains its white colour. Although its distribution is obscure, from its analogy to blood, we may conclude that it is a fluid which visits and nourishes every part of the insect's body ; that from it secretions are made, and that, as in other creatures, it is fitted for these purposes by receiving oxygen from the air-vessels. CUVIER has observed that the blood of insects, "for want of a circulating system, not being able to seek the air, the air goes to seek the blood ;" the air-vessels, as I have stated under the head of Respiration, are distributed to every part of the body.

#### NUTRITION.

From what I have said under the head of Circulation, it will appear evident that the bodies of bees and other insects are supplied with nutriment in a very simple manner. CUVIER is of opinion that it is obtained by direct absorption or transudation, by imbibition as he calls it, through the pores of the intestinal canal, along which the blood or animalized chyle passes : and LYONNET thinks that this imbibition is analogous to that which takes place from the earth by the roots of plants.

#### SECRETION.

Every thing connected with the subject of se-

cretion seems to be obscure : it is evident, however, that secretions do take place ; for silk, wax, and poison are all the results of that process. The first of these substances is only secreted by the bee when in its larva state. I must refer those who wish for information respecting silk, to those naturalists who have written on the silkworm. The secretion of wax I shall treat of hereafter in a distinct chapter ; and it will be better perhaps to speak of Poison, after describing the sting and its appurtenances. There is one secretion however, on which I will say a few words in this place,—viz. Perspiration.

#### PERSPIRATION.

The *temperature of insects* not gregarious, is generally that of the medium they inhabit ; but bees possess the power not only of preserving a high temperature during the coldest months of winter, but of raising that temperature under particular circumstances. DR. DARWIN has observed that they generate heat by a general motion of their legs, as they hang clustered together in the hives : HUBER thinks that it may be increased by the agitation of their wings ;—whatever disturbs them so as to cause a tumult invariably produces a considerable accession of heat. INCH, a *German*, plunged a thermometer into a bee-hive in the winter, and saw the mercury stand 27 degrees higher

than it did in the open air. MR. HUNTER found the *heat of a hive* vary from  $73^{\circ}$  to  $84^{\circ}$  of Fahrenheit; and HUBER, who says that in a prosperous hive the thermometer in winter commonly stands at from  $86^{\circ}$  to  $88^{\circ}$ , and in summer between  $95^{\circ}$  and  $97^{\circ}$ , states that he has observed it, on some occasions, to rise suddenly from about  $92^{\circ}$  to above  $104^{\circ}$ . The former naturalist, about ten o'clock in the morning, in the middle of July, when the quicksilver in the thermometer in the open air ranged at  $54^{\circ}$ , found that on plunging it into a bee-hive, it rose in less than five minutes to  $82^{\circ}$ . At five the next morning it stood at  $79^{\circ}$ ,—at nine it had risen to  $83^{\circ}$ ,—at one to  $84^{\circ}$ ; and at nine in the evening it had fallen to  $78^{\circ}$ . On the 30th of December, when the temperature of the air was  $35^{\circ}$ , that in the hive was  $73^{\circ}$ . Bees also possess the power of counteracting or throwing off superabundant heat, by perspiration. HUBER observed, that when crowded together in hot weather, they become much heated, and perspire so copiously that those near the bottom seem perfectly drenched, and are for a time incapable of flying from the moisture on their wings.

### MOTION.

The *motions of insects* are performed through the medium of an appropriate apparatus of muscles, which move the head, trunk, abdomen, vis-

cera, and limbs, as in other parts of the animal creation. The muscles of insects generally possess very great power, as may be seen by the motion of the mandibles, and the propulsion of the bee's sting. It is very strikingly evinced also in the flea. LATREILLE gives an account of one that dragged a silver cannon twenty-four times its own weight, firing it off afterwards, without exhibiting any symptom of fear. An English workman also is said to have made an ivory coach, with six horses, a coachman on the seat with a dog between his legs, a postillion, four persons in the coach, and four lacqueys behind,—the whole of which was dragged by a single flea. A further evidence of the muscular power of the flea is the extent of its leaps, which equal a space of 200 times the length of its own body. This calculation, or a very similar one, was made by SOCRATES, who was much ridiculed for it by ARISTOPHANES. The poet, however, did not confine his ridicule to this minuteness of calculation, but attacked likewise the character and precepts of that great philosopher ; for the whole of which satire he has justly incurred the censure of posterity.

#### ORGANS OF REPRODUCTION.

These organs, in the drone, correspond in function and denomination with those of the higher

classes of animals: their chief peculiarity consists in their size, in proportion to that of the insect, and in their being more under the belly than in other insects of this tribe;—they are larger than those of the humble-bee, and the two last scales of the back and belly are larger than those of the queen or workers.

The female organs consist principally of the ovaries, the oviducts, the sperm-reservoir, and the ovipositor. In the ovaries the eggs are generated, and remain till rendered fit by impregnation, and the other circumstances necessary for their maturation, to pass through the oviducts. According to Mr. Hunter, what are called ovaries are really ducts; the eggs therefore are not formed as in other animals, in a cluster on the back, but in those ducts, of which there are six on each side. When full of eggs, they form a kind of quadrangle; these six ducts uniting on each side into one duct, this latter enters a duct common to both sides, which may be called the *vagina* or *ovipositor*. The common *oviduct* is the canal through which the eggs pass from the ovaries as they are called, to the ovipositor. The *sperm-reservoir* is the organ which, according to Herold, receives the *impregnating sperm* of the drone, the *modus operandi* of which we are unacquainted with. In the hive-bee and in some other insects, the influence of this sperm continues so long

a time, and through so many generations, as almost to exceed belief. (*Vide* page 31). This led DR. HAIGHTON to entertain the opinion that actual contact betwixt the male sperm and the egg was not necessary, but that impregnation was effected by some unknown sympathetic influence. MESSRS. KIRBY and SPENCE have recourse to the old doctrine of an *aura seminalis* being all that is required to vivify the egg, and which they think may be retained for a long period. Upon this subject I have entered at some length in page 25 *et seq.* The *ovipositor* places the eggs in their appropriate situations, and is an instrument of most curious structure. It consists of a long tube, or rather several tubes, retractile within each other, like the pieces of a telescope, and serves not only to convey the extruded eggs to the place of their destination, but acts also as a sheath for *the sting*, having a sharp point which makes the first impression when the creature intends to use its sting,—indeed it appears to be itself the sting. It has a slit near its extremity, through which the sting and poison are allowed to pass at the time of stinging. Some insects have occasion to bore a hole in wood, or other hard substances, to obtain a proper nidus for their eggs; the *ovipositor* is their operating instrument, and will either saw or bore a passage to the desired place. Thus it appears that this curiously com-

plex apparatus, which in the bee is used both as a weapon of defence and offence, is a hollow horny tube or scabbard, inclosing two bearded darts, which can be thrust a short way beyond the sheath, though the whole appears to the naked eye like the solid point of the minutest needle.

This apparatus is moved by muscles which, though invisible to the eye, are yet strong enough to force the sting to the depth of one twelfth of an inch through the thick cuticle of a man's hand. It is articulated by thirteen scales to the lower end of the insect's body; and at its root are situated two glands or ducts, from which the poison is secreted: these glands uniting in one duct, eject the venomous liquid along the groove formed by the junction of the two piercers. There are four beards on the outside of each piercer: when the insect is prepared to sting, one of these piercers, having its point a little longer or more in advance than the other, first darts into the flesh, and being fixed by its foremost beard, the other strikes in also, and they alternately penetrate deeper and deeper, till they acquire a firm hold of the flesh with their hooks, and then follows the sheath entering and conveying the poison into the wound. The action of the sting, says PALEY, affords an example of the union of *chemistry* and *mechanism*: of chemistry, in respect to the *venom* which can produce such powerful effects: of mechanism, as

the sting is a compound instrument. The machinery would have been comparatively useless had it not been for the chemical process, by which in the insect's body *honey* is converted into *poison*; and on the other hand, the poison would have been ineffectual, without an instrument to wound, and a syringe to inject it.

In consequence of the barbed form of its sting the bee can seldom disengage itself without leaving behind it the whole apparatus, and even part of its bowels; so that her life is usually sacrificed to her passion.

“ Illis ira modum supra est, læsæque venenum  
Morsibus inspirant, et spicula cæca relinquunt,  
Affixæ venis, animasque in vulnera ponunt.” VIRG.

*The sting of the queen-bee* is longer and stouter than that of the working-bee, and bends a little under her belly. She is not eager to employ it; and from what has been said above, of the fatality which usually attends its use, conjecture has been busy as to the cause of her extreme caution in this respect. DR. EVANS observes, that it cannot arise from any selfish consideration, founded on an instinctive knowledge of the danger she thereby incurs; since the common bees, who run the same risk when they sting, are ready to attack upon the slightest provocation. “Is it owing,” says he, “to a consciousness of the importance of her

life to the community? or may we rather ascribe it to the dignified and generous forbearance so frequently exemplified in the lion or English mastiff?"

The reluctance of queens to eject their stings, led Pliny and others to imagine that they did not possess any. Their extreme caution in this respect, and the fatal consequences usually attending a departure from it, gave birth to the following jeux d'esprit. In consequence of Pope Urban the Eighth being suspected of a stronger attachment to the French than to the Spaniards, a Frenchman who had observed *three bees* quartered upon his arms, wrote this Latin verse.

"Gallis mella dabunt, Hispanis spicula figent."

To this a Spaniard is said to have subjoined,

"Spicula si figant, emorientur apes."

To close the series, and to show his universal paternal regard towards his flock, Pope Urban is made to add the following distich:

"Cunctis mella dabunt, et nullis spicula figent,  
Spicula rex\* etenim figere nescit apum."

This *caution of the queens* is never more conspicuously evinced than *in their combats with each*

\* The ancients supposed the sovereign of the bees to be a male.

*other*, for they instantly separate if there be any danger of *mutual* destruction from the darting forth of their stings. HUBER gives a striking instance of this. Two queens in one of his hives having left their cells at nearly the same instant, rushed together with great apparent fury. The antennæ of each were seized by the teeth of the other, and the head, breast, and belly of both were mutually opposed. Finding themselves however thus dangerously situated, and their curved extremities on the point of meeting, each disengaged itself and flew away; when the other bees, who had before receded, to make a clear arena for the combatants, drove them together again. This was done repeatedly, till at last the stronger queen, seizing the other's wing, and curling her extremities under her belly, inflicted a mortal sting.

I think this observation of Huber puts a negative upon Dr. Evans's last question, and to assent to his first would I apprehend raise her majesty too high in the scale of existence. I believe we must here, as in many other similar cases, acknowledge our ignorance, and refer the proceeding to instinct.

We have seen that where there is more than one native queen in a hive, there is always a combat between them, terminating in the death

of all but one. It was the opinion of SCHIRACH and RIEM, that if a stranger queen were introduced where there was a native one, the former would be assailed by the workers, and by them stung to death. The experiments of HUBER and DUNBAR discountenance this opinion: indeed Huber says that in the whole course of his experience he never knew more than one instance of a queen's being stung by a worker, and that was wholly unintentional.

But though the experiments to which I have just alluded, produced different results from what we were led to expect by Schirach and Riem, yet those of HUBER did not correspond with those of DUNBAR. The former introduced two stranger queens into hives containing native queens; of the latter, one was fertile the other a virgin,—the former were both fertile. Each of these introductions led to a single-combat between the queens, and each terminated in the death of the stranger. The latter gentleman also on two occasions introduced stranger queens to the queens regnant, in his mirror hive; but in neither case were they stung to death, either by the queen or workers, but merely surrounded and confined by the latter, and by that confinement either suffocated or starved to death. SCHIRACH and RIEM had probably witnessed similar conduct on the part of the

workers, and were no doubt led thereby to conjecture that they dispatched the queens with their stings.

From what has been said of the fatal consequence to the bee itself when it makes use of its sting for the annoyance of man and other animals, it might be supposed that the darting of this weapon by one bee into the body of another, might cause the death of both; but this is not usually the case, otherwise there would be a great mortality amongst them, when the persecution of the drones takes place. HUBER contrived, by placing several of his hives upon a glass table, to witness this scene of massacre; on which occasion the bees thrust their stings so deeply into the bodies of the drones, (generally between the segments of the abdomen,) as to be obliged to turn upon themselves, as upon a pivot, before they could extricate them; but by so doing they succeeded, as do the queens also in their combats with each other. Instances are related, of combats between workers proving mutually destructive, from the victors being unable to extricate their stings from the wounds they have inflicted. MR. HUNTER saw an instance of this: the bee was stung in the mouth; and he saw it running about afterwards, with the sting and its appurtenances adherent in the wound.

Indeed by allowing the bee to draw out her

sting gradually, when we ourselves are stung,—which if we had sufficient firmness and presence of mind to remain still, she would instinctively do, by bringing the beards close down to the sides of the darts,—the life of this valuable insect might be preserved, and the pain in the wounded part be much lessened: but the alarm of both parties seldom admits of such forbearance. The wasp is not so liable to leave its sting behind as the bee, the beards of the former being rather shorter, and the insect stronger and more active.

The sooner the sting is extracted the less venom is ejected, and consequently less inflammation induced. To alleviate the irritation, numberless *remedies* have been proposed, of the most opposite kind and uncertain effect; as oil, vinegar, bruised parsley, burnet, mallow, or the leaves of any succulent vegetable (renewed as soon as warm, and probably therefore operating by cold alone), honey, indigo dissolved in water, &c. &c. The *most effectual* remedy appears to be the *Aq. Ammon.* or *Spirit of Hartshorn*: nor is this surprising, when we consider that *the venom of the bee, or wasp, is evidently acid.* If a humble-bee be irritated to sting paper tinged with litmus, or any other of the vegetable blues, the colour is changed by the acid of the venom to a bright red; this acid appears not to differ from the acid (*bombic*) of silk-worms, or (*formic*) of ants. The acrimony of the latter

many have experienced when inadvertently sitting down on an ant-hill. On this principle, a solution of any alkali, or even lime-water, might answer the same purpose; and soap would have the double advantage of neutralizing the acid and allaying the inflammation, by the oil which would be disengaged. Plunging the part stung into cold or warm water would afford the same relief as in burns, &c. and also dilute the acid acrimony. Quietness is the surest protection against being stung. It has lately been affirmed, that a person is perfectly secure amidst myriads of bees, if he carefully keep his mouth shut, and breathe gently through the nostrils only, the human breath being, as it would appear, highly offensive to their delicate organs. (*Vide Senses of Bees.*) It is added that with this precaution, hives may be turned up, and even part of the combs cut out, while the bees are at work, with perfect impunity.

Those who wish to view the sting of a wasp or bee through a microscope, may cut off the end of its tail, when by touching it with a needle or pin it will thrust out the darts and their sheath, which may be then snipt off with a pair of scissors and reserved for observation. If the insect be caught in a leather glove and provoked to eject its sting, the same end will be answered; as the sting being detained by its barbs, will be left in the leather, from whence, when the creature is dead (which in

the case of a wasp will not be for many hours), the whole apparatus may, with care, be extracted.

“Upon examining the edge of a very keen razor by the microscope, it appeared as broad as the back of a pretty thick knife, rough, uneven, and full of notches and furrows, and so far from any thing like sharpness, that an instrument as blunt as this seemed to be, would not serve even to cleave wood\*.” “An exceedingly small needle being also examined, the point thereof appeared above a quarter of an inch in breadth ; not round, nor flat, but irregular and unequal ; and the surface, though extremely smooth and bright to the naked eye, seemed full of ruggedness, holes, and scratches. In short it resembled an iron bar out of a smith’s forge†.” But the sting of a bee, viewed through the same instrument, showed every where a polish most amazingly beautiful,—without the least flaw, blemish, or inequality ; and ended in a point too fine to be discovered : yet this is only the case or sheath of instruments much more exquisite, contained therein, as before described.

#### THE POISON OF BEES.

The *poison of bees*, as also that of wasps, is a transparent fluid : applied to the tongue it im-

\* Hook’s Microcosm.

† Philosophical Transactions.

parts a sweet taste, which is succeeded by a hot acrid one. It gives a slight red tinge, as has been already hinted, to litmus paper, and hence the **ABBE' FONTANA** has concluded that an acid enters into its composition, but in very small proportion. The venom is so extremely active, that he conjectures a grain in weight would kill a pigeon in a few seconds. It is this fluid which causes the inflammation consequent upon being stung. A puncture from a needle that was charged with it, would produce precisely the same effects. These effects are very different in different persons; for whilst a single sting will produce alarming symptoms in one individual, another may receive numerous punctures without sustaining pain or inflammation in any considerable degree; sometimes without suffering either. The activity of the venom varies according to the season of the year: a sting received in winter produces much less inconvenience than one inflicted in summer; the pain and inflammation are neither so intense nor of such long continuance. This may arise from there being a more copious secretion of venom in summer than in winter; for during the former season, if a bee inflict several wounds with its sting, the pain and inflammation become progressively less at each consecutive puncture: after three or four punctures, it is rendered incapable of producing more inconvenience than the point of a sharp needle.

If a bee be provoked to dart its sting against glass, so as to eject its venom upon it, and the glass thus charged be placed upon a double microscope, oblong pointed crystals will become visible; these may be seen at first floating in the venom, and gradually shooting into crystals as the fluid part evaporates.

### THE ANGER OF BEES.

I have already treated of the disposition of bees to use their stings, when irritated, either by direct interference with them, or by the approach of persons to whom they have an antipathy. VIRGIL has, in strong terms, noticed their irascibility:—when once provoked, says he, they set no bounds to their anger, but

“Deem life itself to vengeance well resign’d,  
Die on the wound, and leave their stings behind.”

*Fatal consequences* occurring from their wounds are not often heard of, though such I believe have occasionally happened. MESSRS. KIRBY and SPENCE relate an instance of a violent fever being produced, by the injury they inflicted, and in which the person’s recovery was for some time doubtful. MUNGO PARK also mentions, in his Travels, an instance of severe annoyance from them, and states that he lost several asses in Africa owing to their being attacked by bees.

MR. TALBOT, in his Five Years Residence in the Canadas, states, that during the summer of 1820, the *Rev. Ralph Leeming* having sent a fine horse to grass at a neighbouring farmer's, who kept about twenty stocks of bees, the animal got upon the lawn where the hives were placed, and by accident overturned one of them, the bees of which attacked him with great virulence. The horse, rearing and kicking from agony, overthrew another hive. Having thus doubled the number of his assailants, his sufferings brought him to the ground, and in less than five minutes from the commencement of the attack the poor animal was literally stung to death.

The anger of bees is not confined to man, and other large animals ; it is sometimes vented upon their own kind, not only in single combat, but in conflicts of organized masses. Cases of the former kind every observer must have noticed ; and of the latter, several instances have been related by REAUMUR, THORLEY, KNIGHT, and others. The engagement, witnessed by THORLEY, lasted more than two days, and originated in a swarm's attempting to take possession of an already occupied hive. Remarkable battles of this kind have also been related by other writers. Whenever the angry excitation is diffused through a whole community, a great accession of heat is produced in the hive.

Notwithstanding bees are thus occasionally animated by a most vindictive spirit, against what they regard as a public enemy, they are not found to display any peculiar hostility in the revenge of a private injury, committed upon them at a distance from their homes. This is a fact which has been noticed both by MR. HUNTER and MR. KNIGHT. The former observes also, that bees *never* sting but in the neighbourhood of their property, unless hurt; that they never contend with each other for honey, unless it be placed within the boundary of their own right,—but that what they have collected they defend. The indisposition of bees to attack or be angry at a distance has been confirmed by MR. KNIGHT, who says, that, though the most irritable of animals near home, he has seen them suffer themselves to be patiently robbed of their loads by other bees, and that he has witnessed this in the same bee three times in succession. He says likewise, that if the wasps in a nest have their communication cut off from those that are abroad, the latter, on their return, will not make any attack; but that if one escape from the interior, it evinces a very different temper, and is ready to sacrifice its life to avenge the injury. This MR. KNIGHT discovered when a boy, and he has no doubt but that if a similar proceeding were adopted towards bees, they would observe the same conduct.

## THE LANGUAGE OF BEES.

All creatures that live in society seem to possess the power of communicating intelligence to one another. "Brutes," says MR. KNIGHT, "have language to express sentiments of love, of fear, and of anger; yet they seem unable to transmit any impression they have received from external objects. But the language of bees is more extensive: if not a language of ideas, it is something very similar." This faculty has been very remarkably illustrated by HUBER in his Treatise on Ants; and the bee exhibits many strong evidences of it. HUBER clearly shows that the communications of Ants are made through the medium of their antennæ; he has also proved very satisfactorily, that these organs serve the same purpose in bees.

Being desirous of ascertaining whether when a queen was removed from a hive, (a circumstance which is communicated to the whole family within an hour,) they discovered their loss by means of smell, touch, or any unknown sense; he accordingly divided a hive into two portions, by means of a grating which admitted a free circulation of air, but denied a passage to the bees, or even to their antennæ: the consequence was, that the bees contained in the half that had no queen, after they had recovered from the agitation\* always pro-

\* This agitation usually continues two or three hours, sometimes (though but seldom) four or five,—never longer.

duced under such circumstances, set about building royal cells, just as they would have done if the queen had been entirely removed from the hive. He repeated this experiment, with a grating which allowed the transmission of the antennæ only. Here the effect was quite different: for the bees being able to assure themselves, by the frequent crossing of their antennæ with those of the queen, that she was still amongst them, every thing remained in order; the brood were attended to, no interruption took place in any of their labours, nor were any royal cells commenced. From all these experiments (and they were repeatedly tried), it seems evident that the antennæ of bees, as well as of ants, possess the faculty of receiving and conveying information. Bees receive some kinds of intelligence through the medium of certain sounds, as has been stated in another place.

*The antennæ, in addition to the uses already ascribed to them, may serve to inform the bees of the state of the atmosphere, and enable them to discern the approach of a change in the weather.* The suddenness and rapidity of their flight towards the apiary, often afford a hint to the observer of their proceedings, that a storm is at hand, of which he received no intimation from any other quarter.

“Inque vicem speculantur aquas et nubila cœli.”

VIRGIL.

“That the bees,” says DR. EVANS, “can foresee

bad weather, is a fact beyond denial ; though we know not through the medium of what sense that faculty is exerted. We are often surprised to find, even with a promising appearance of the sky, their labours suddenly cease, and that not a bee stirs out ; or, on the contrary, that those which are abroad, hurry home in such crowds that the door is too small for their admission. But on strictly examining the heavens, we may discern some small and distant clouds, which, insensibly collecting, soon after descend in rain." The Doctor likewise says, that an observant friend of his, foretells with confidence that rain will fall in the course of a few hours, when he finds on a clear summer's morning that his garden is wholly deserted by his neighbour's bees. In this he enjoys an advantage over their real owner, the flowers near the apiary being crowded as usual by these wary foragers. "If," says MR. KIRBY, "they wander far from home, and do not return till late in the evening, it is a prognostic to be depended upon, that the following day will be fine : but if they remain near their habitations, and be seen frequently going and returning,—although no indication of wet should be discoverable, clouds will soon arise and rain come on. Ants also are observed to be excellently gifted in this respect : though they daily bring out their larvæ to the sun, they are never overtaken by sudden showers."

I have before stated that in the course of an hour the important intelligence of the loss or safety of a queen is known to a whole colony. It seems highly improbable that in this time, 20,000 bees should have assured themselves of the presence and safety of their queen, by applying their antennæ to hers; such an attempt would create a state of complete confusion. Huber proved by a very decisive experiment, similar to those already related, that the queen is not distinguishable by her subjects, in consequence of any emanation from her person. There must then be some mode, to which I have given the name of language, by which those who have exchanged contact with their antennæ can communicate the tranquillizing intelligence to their companions. It seems impossible to explain, in any other way, the concurrence of so many wills to one end; or that sudden interruption and restitution of harmony which are often exhibited in every community of bees. It is the opinion of MR. KNIGHT that bees are not only capable of communicating intelligence to the members of their own family, but that a friendly intercourse sometimes takes place between neighbouring colonies: the cases which he has related in support of this opinion, however, can hardly be said to bear him out in it; for in each of them, after the intercourse had continued for a few days, it terminated in violent hostility. Such instances,

though not of frequent occurrence, have been occasionally noticed by others.

### SLEEP OF BEES.

It is reasonable to suppose that every part of animated nature needs occasional intervals of repose. That this is the case with the bee seems evident, from the almost motionless quietude of the workers, which often occurs for fifteen or twenty minutes together, each bee inserting its head and thorax into a cell, where it might be mistaken for dead, were it not for the dilatation of the segments of its abdomen. The queen sometimes does the same in a drone's cell, where she continues without motion a very long time, when "the workers form a circle round her, and gently brush the uncovered parts of her abdomen. The drones while reposing do not enter the cells, but cluster in the combs, and sometimes remain without stirring a limb for eighteen or twenty hours." HUBER says that he has seen the workers, even in the middle of the day, when apparently wearied with exertion, insert half their bodies into the empty cells, and remain there, as if taking a nap, for half an hour or longer ; at night they regularly muster, in a sleep-like silence.

" The sun declining, through the murky air,  
Home to their hives the vagrant bands repair,

There in soft slumber close their willing eyes,  
And hush'd in silence, the whole nation lies."

MURPHY'S VANIERE.

### LONGEVITY OF BEES.

The several members of a hive have very different periods of existence. The general law among insects is, that both male and female shall perish soon after sexual union; in a few days or weeks at furthest, according to the time, probably, that the female occupies in maturing and depositing her eggs. By retarding sexual union, the lives of some insects may be very much prolonged,—even ephemeræ have been kept alive by this means for seven or eight days. Annual plants, if prevented from seeding, may be rendered biennial. The bee and some other insects are exempted from this forfeiture of life after sexual union, with the exception already alluded to in page 33. The ancients were very deficient in knowledge upon this subject. VIRGIL fixes the term of a bee's existence at seven years\*, having probably copied from ARISTOTLE; though Aristotle says that bees who live to an extreme old age may reach to nine or ten years. COLUMELLA †

\* "Ergo ipsas quamvis angusti terminus ævi  
Excipiat, neque enim plus septima ducitur æstas."

† "Durantque, si diligenter excultæ sint, in annos decem."

COLUMELLA.

and PLINY \* have been supposed to regard their existence as extending to ten years ; though the language of the former applies to the existence of the community, and not to individual bees : and provided the hive be never changed, nor the combs renewed, it is not likely that any one family should have its existence prolonged beyond that period ; as the accumulation of silken pellicles with which the breeding cells are successively lined, would render them unfit for use in a very few years. In addition to the diminution of the cells by this succession of silken linings, they are also diminished further by the excrement of the larvæ, which is never cleaned out, but confined behind each lining : both together, therefore, soon render the cells unfit for use as brood cells. MR. HUNTER found three of these layers deposited in a single season, and counted upwards of twenty in the cells of an old comb ; which, upon an average of three a year, would correspond with the period fixed by the ancients ; though this observation by no means proves that the hive upon which it was made, or any other, might not have had a much more protracted existence. MR. ESPINASSE tells us that he once took a hive which had stood fourteen years, having found that it had become

• “ Alveos nunquam  
Ultra decem annos durasse proditur.” PLINY.

weak : it had nevertheless sent off a swarm the year previous. There is an instance or two on record, of one family having continued in the same hive for thirty years. One of these is mentioned by REAUMUR, another by MOUFFET. THORLEY speaks of a colony having occupied the same domicile for 110 *years*. The spot chosen was under the leads of the study of LUDOVICUS VIVES in Oxford : the original swarm settled there in 1520 and kept possession till 1630. Query,—may not the bees when the combs become very old and the cells much diminished in size, remove them and construct fresh ones ? To those who may wish for their own satisfaction to examine the linings of a brood cell, I would observe, that MR. HUNTER's mode of proceeding was, to soak the cell in water, till the linings were swelled, when he had no difficulty in separating and counting them : he found them separate most readily at the bottom, on account of the inclosed excrement.

To common observers it might appear, that the lives of the bees were coeval with the foundation of the colony, presuming upon all the young bees leaving the parent stock in swarms. But I have already stated that all swarms consist of a mixture of young and old bees ; the difference between them is very distinguishable, those of the present year being brown, plump, and clothed

with light hairs, whilst the old ones have red hairs, notched and ragged wings, and are paler and more shrunk in their bodies.

The cases which I have related, and others of a similar kind, have led to the erroneous opinion that bees are a long-lived race. But this, as DR. EVANS has observed, is just as wise as if a stranger, contemplating a populous city, and personally unacquainted with its inhabitants, should on paying it a second visit, many years afterwards, and finding it equally populous, imagine that it was peopled by the same individuals, not one of whom might be then alive. "Such strangers are we to the honied hive, where, however quickly its generations may have passed away, the same face is presented to the beholder."

"The race and realm from age to age remain,  
And time but lengthens with new links the chain."

SOTHEY'S GEORGICS.

The usual term of the male's existence is two or three months only ;—I say the usual term, for his life is always cut off by violence, when no peculiar circumstances arise to render his existence any longer useful. Such circumstances having arisen, as has been before observed, (page 44,) he may be kept alive a much longer period, for a year at least, but how much longer has not as yet been ascertained.

With respect to the queen, by comparing what has been said above, as to insects not dying till their eggs are all matured, with what has been stated in page 31 of a single sexual union serving to impregnate all the eggs laid for the two succeeding years, it would appear that the period of her existence could not, in general, be less than two years; and HUBER has proved very satisfactorily, that this is the fact: indeed he states that he has known a queen live for five years. FEBURIER suspects that, like the males, the queens are destroyed by the labourers, when they have fulfilled their destination. The only ground of this opinion, however, appears to be his having witnessed an attack made upon a queen by six labourers, from whom he with difficulty rescued her. MESSRS. KIRBY and SPENCE, in like manner, seem to think it not improbable that when the workers become too old to be useful to the community, they are either killed or expelled the society. *Vide* page 7. Reaumur also throws out a hint to the same purpose.

The length of a working bee's life has not yet been ascertained; but the general opinion is that it is short-lived. BUTLER says that "the bee is but little more than a year's bird;" and some think the period of its existence shorter still. "The bees of the present year," says BUTLER, "will retain their vigour and youthful appearance till

(Gemini), about the 21st of May in the following year, when they begin to decline, and from (Cancer to Leo) June 21st to August 21st, the ground in front of the apiary may be seen strewed with them, some dead, some dying, and a few alive but incapable of rising again, and by (Libra) 22d September, scarcely an old bee will be left."

## CHAPTER XXXII.

## SENSES OF BEES.

IN considering the phænomena of insect sensation, little advantage can be derived from analogy ; the physiology of the senses of bees, and other insects, is therefore but imperfectly understood. Still they must have credit for the *possession* of senses, however differently modified from those of man. Some of their senses may open avenues to knowledge, with which he must ever remain unacquainted. Arts which he is obliged to attain by long labour and great diligence, they seem to derive from nature, through the medium no doubt of organs so exquisitely fine, as to elude not only his search, but even his conception.

Of all the senses of bees, none appears to be so acute as that of SMELL.—It is this which, in all probability, enables them to distinguish, not only individuals of their own species, but one human being from another ; and also to discover honey-dews and honey-bearing flowers, at a very considerable distance ; (honey of all odorous substances, being the most attractive to them :) it may tend likewise to cause that neatness which they observe in themselves and in their habitations. An experiment, made by HUBER, demonstrates that they

possess the faculty of smell. He placed vessels of honey in boxes perforated with very small holes, to allow the odorous effluvia to escape, but not of sufficient size to permit a sight of the honey, when the bees came directly to the boxes. He also tried this experiment with the addition of small card valves, which the bees, after examining the boxes all round, contrived to raise up, that they might get at the honey. MR. HUNTER states, that he has seen great commotion produced in a recent swarm in wet weather, when he supposes the bees to have been hungry, by placing honey on the floor of the hive. It was a glass hive, which afforded him a good opportunity of observing their proceedings, and he says that all of them appeared to be upon the scent : even those that were weak and hardly able to crawl, threw out the proboscis as far as possible, to get at the honey, which he thinks must have arisen from their smelling and not from their seeing it.

This presumed nicety of their smell should induce a carefulness that no offensive odours be near an apiary. The notorious frequenting, by bees, of the depositories of urine and the dung of animals, might seem to render such carefulness futile : but upon this subject I have written in a former chapter, and have since had the pleasure of seeing my opinion confirmed by that of MESSRS. KIRBY and SPENCE.—Bees appear to have an

antipathy to particular individuals. Their aversion, in all probability, arises from the persons disliked having some peculiar odour about them, which though not unpleasant to man, may be so to bees. Whatever the odour, it seems to be transmitted by the breath: HUBER was of this opinion. Speaking of the impunity with which his assistant *Francis Burnens* performed his various operations upon bees, he observes that "the gentleness of his motions, and the habit of repressing his respiration, could alone preserve him from the wrath of such formidable insects."

The different reception which persons experience on approaching the domicile of bees is attributed by some apiarians to the different degrees of confidence manifested in the approach: they are of opinion, that if visitors could avoid the exhibition of all apprehension, they would not be attacked. My own experience has long convinced me of the erroneousness of this opinion: and a circumstance which occurred to MONSIEUR DE HOFER, *Conseiller d'état du GRAND DUC DE BADEN*, strengthens my dissent from it. He had for years been a proprietor and an admirer of bees, and almost rivalled Wildman in the power he possessed of approaching them with impunity: he would at any time search for the queen, and taking hold of her gently, place her upon his hand. But having been unfortunately attacked with a violent

fever, and long confined by it ; on his recovery he attempted to resume his favourite amusement among the bees, returning to them with all that confidence and pleasure which he had felt on former occasions ; when to his great surprise and disappointment he discovered that he was no longer in possession of their favour ; and that instead of being received by them as an old friend, he was treated as a trespasser : nor was he ever able, after this period, to perform any operation upon them, or to approach within their precincts, without exciting their anger. Here then it is pretty evident that some change had taken place in the Counsellor's secretions, in consequence of the fever, which though not noticeable by his friends, was offensive to the olfactory nerves of the bees. I had this anecdote from Monsieur de Hofer's son, with whom I passed a very agreeable evening in London at the house of my friend Joseph Hodgetts, Esq.

The extreme sensitiveness of smell in bees is evinced by their promptitude in resenting an injury inflicted on any of their community. In hiving, or performing any other operation upon them, great caution should therefore be observed, lest any of them be trodden upon or crushed to death. It may be thought that this promptitude to resent the injury I have here mentioned, may not proceed from the acuteness of their smell,

but from an effect produced upon some other organ of sense. I infer that it proceeds from the former, on account of their being so quickly roused to anger from a state of tranquillity, by having a fresh envenomed sting and its appendages presented before the entrance of their dwelling. This experiment, of presenting fresh poison to the bees, was tried by HUBER in such a variety of ways, as to prove beyond all doubt that it was the penetrating odour of the poison only, and not the manner of presenting it, that affected them; for when the poison had coagulated, the same mode of presentation produced no sensible effect, it might be offered them with perfect impunity.

Butterflies and Moths are supposed to be directed by this sense to the discovery of their mates. If the female of the eggar moth (*Phalæna quercus*) be inclosed in a box, and placed in the neighbourhood of the males, they are attracted to the spot in such numbers as to show clearly that they are sensible of her presence. We have analogous instances of the existence of this faculty in other insects. The flesh-fly (*Musca vomitoria*) occasionally deposits its eggs on plants of the *Stapelia* genus, no doubt from their odour resembling that of putrefying flesh. This may be regarded by some as an evidence of mistaken instinct; but from what I have said in the chapter on Instinct, I think that my readers will consider

this to be erroneous, and that it should rather be regarded as affording presumptive evidence of mistaken judgement. Instinct would direct the creature to deposit its eggs where the larvæ when hatched would be furnished with the means of subsistence, instead of thus exposing them to perish. At all events it affords tolerably good evidence of the existence of an organ of smell in the insect.

The sense of Touch in bees, that is their active or exploring touch, seems to be very acute. To the nicety of this sense has been attributed their power of commencing and carrying on their works amid the darkness of the hives. The recognition of their queen evinces the existence of some such sense ; for the experiments related at page 292, indicate that her presence is not ascertained either by the organs of sight, hearing, or smell.

The ANTENNÆ have generally been considered as their organs of touch ; and indeed, in popular language, they are usually called Feelers or horns ; they have likewise assigned to them the office of wiping and cleaning the eyes. The antennæ, however, are not regarded as feelers by our leading entomologists : at present their uses are not clearly defined. Some have regarded them as organs of smell ; others as organs of hearing ; a third party have conceived that they perform some function of which man has no definite idea,—supplying the

insect with a sixth sense, an intermediate faculty, according to MESSRS. KIRBY and SPENCE, between hearing and touch, rendering it sensible of the slightest movement of the circumambient air. DR. EVANS designates the antennæ as their sight-supplying sense ;

“ The same keen horns, within the dark abode,  
Trace, for the sightless throng, a ready road,  
While all the mazy threads of touch convey,  
Shot inward to the mind, a semblant day.”

EVANS.

The antennæ, of which there are only a single pair, proceed from the anterior part of the head before the eyes.

The PALPI are generally considered as the true feelers ; which, as well from their texture as from the manner in which insects apply them to their food before they begin to eat it, seems probable : Cuvier and Lehmann were of this opinion. The palpi are attached to the under jaws and lips, and are four in number. In some respects they bear analogy to the antennæ ; but the latter, being more articulated, have an extended power of motion. Some insects with small antennæ are observed to have very large palpi, which gives reason to suppose, that although their offices may be different, they are intended to assist each other.

The antennæ appear to be the more important organs of the two ; as the palpi, when removed, have not been found to occasion much apparent inconvenience ; whilst from the experiments of HUBER and others, it appears that the excision of the antenna deprives the insect of the perfect exercise of its functions. It seems immediately to lose its instincts. The amputation of one antenna produces no effect ; but if both be cut off near the root, the bee no longer possesses the power of guiding itself ; it cannot direct its tongue to receive food from its companions, nor take any share in the operations of the family ; but exhibits perfect indifference, and keeps near the entrance, apparently for the sake of light ; when that is withdrawn, it soon leaves the hive to return no more. “ Their departure,” says HUBER, “ must be ascribed to the loss of that sense, which is employed to guide them in the dark.”

That bees possess a fine sense of TASTE, may be readily conceived from the delicious food which they collect, and from their having a preference for those flowers that afford the best honey, whenever such flowers grow abundantly in the neighbourhood of the hives. Hence the superiority of the honey of Narbonne, Hymettus, and Pontus. HUBER regards Taste as the least perfect of the senses of bees, but the reasons he gives for this opinion are unsatisfactory. Indeed the tongue of

the bee is an organ so considerably developed, as to afford very strong evidence of its power of discrimination in the selection of food. CUVIER considers it to be one of the primary functions of its organization.

There is tolerably good presumptive evidence that bees have a quick sense of HEARING, from their being so sensibly affected by different sounds. The voice of the queen, for instance, has according to BONNER and HUBER an almost magical effect upon them ; and the practice of making some sort of noise at the time of hiving is founded upon this opinion. HUBER is of opinion that if bees do possess the sense of hearing it is differently modified from the same sense among beings of a higher order. The consequences which ensue upon the production of certain sounds either by themselves or others, show that the vibrations of the air make an impression upon some sense : HUBER, for reasons which he does not well define, designates it as a sense analogous to hearing, a something acting in concert with and in aid of the antennæ.

LINNÆUS and BONNET thought that insects do not possess the sense of hearing ; but I think they were mistaken. I have just stated the effect produced by the voice of a queen bee, under particular circumstances ; and there are other evidences, equally strong, to show that insects possess this faculty. One grasshopper will chirp in re-

sponse to another, and the female be attracted by the voice of the male. BRUNELLI shut up a male in a box, and allowed the female her liberty : as soon as the male chirped she flew to him immediately. For further evidence of the existence of this faculty in insects, see page 262. (Organs of Sensation.)

The EYE-SIGHT of bees, notwithstanding the wonderful mechanism of their eyes, seems less perfect than their other senses : on some occasions it scarcely serves them to distinguish the entrance of their hives, when they come home loaded with provision. WILDMAN says that he has observed them go up and down, seeking the door of the hive, and be obliged after alighting to rise again in order to find it : he conceived that they see better when flying than when on foot. I believe, however, that this opinion of WILDMAN will not, upon examination, be found quite correct. The mere act of flying does not enable them to see objects better ; but when on the wing, they are at a greater distance from those objects, the eyes of these insects being so constructed as to enable them to see best at a moderate distance. As DR. EVANS has justly remarked, therefore, “ the poet’s disdainful allusion to a

Fly whose feeble ray scarce spreads  
An inch around —

should here be exactly reversed.” DR. DERHAM in

his Physico-theology has observed, when speaking of the eye of the bee and other insects, that "the cornea and optic nerves, being always at one and the same distance, are fitted only to see distant objects, but not such as are very nigh." This visual orb, this seemingly simple speck, though really complicated piece of mechanism, says DERHAM, "will be found upon examination to form a curious lattice-work of several thousand hexagonal lenses, each having a separate optic nerve ministering to it, and therefore to be considered as a distinct eye\*. M. LEEWENHOECK, having properly prepared and placed an eye of this kind betwixt his microscope and a church steeple (299 feet high and 750 distant), saw plainly the steeple inverted, through every different lens, though each lens was not larger than a needle's point. Yet, doubtless the insect perceives but a single object, and that in an upright position. The hemispheric arrangement of these lenses enables the bee to see accurately in every direction, and without any interval of time or trouble."

"Not huge Behemoth, not the Whale's vast form,  
That spouts a torrent, and that breathes a storm,

---

\* The multitude of hexagonal lenses which compose the eye of a bee, make it appear, when viewed through a microscope, exactly like honey-comb.

Transcends in organs apt this puny fly,  
Her fine-strung feelers, and her glanceful eye,  
Set with ten thousand lenses." EVANS.

The eyes of all insects are immoveable, and have neither iris nor pupil nor eyelids to cover them : but this apparent defect is amply made up to them in a variety of ways : in the case before us, by the complex structure of the organs. REAUMUR performed an experiment similar to that which I have just related of LEEWENHOECK, and with a like result. HOOKE computed the lenses in the eye of a horse-fly to amount to nearly 7000. LEEWENHOECK found more than 12,000 in that of a dragon-fly ; and 17,325 have been counted in the eye of a butterfly. The lenses are most numerous in the beetle, and so small as not to be easily discoverable under a pocket microscope, except the eye be turned white by long keeping.

The peculiar construction of the bee's eye, for seeing objects best at a moderate distance, will account for the circumstance noticed by WILDMAN, and also for the following observation of DR. EVANS. "We frequently observe bees flying straight homewards through the trackless air, as if in full view of the hive, then running their heads against it, and seeming to *feel* their way to the door with their antennæ, as if totally blind." SIR C. S. MACKENZIE remarked the imperfect vision of bees, and how very much puzzled they are to

find the entrances to their hives, if the relative position of the entrances be altered, or the hives be removed two or three yards from the place where they have usually stood. In cases of removal, the bees do not during the first day fly to a distance, nor till they have visited and recognized neighbouring objects. MR. ROGERS, in his "Pleasures of Memory," has noticed this defective vision in the bee. Having spoken of her excursive flights to a distance, and referred to her bending her course homewards again, he observes,

"That eye so finely wrought,  
Beyond the search of sense, the soar of thought,  
Now vainly asks the scenes she left behind ;  
Its orb so full, its vision so confined !"

And he concludes that it is by the aid of memory that she retraces her passage back to the hive, by recognizing the scents of the various flowers which she has passed or visited on her outward journey,—

"The varied scents that charm'd her as she flew."

But this idea, as Messrs. Kirby and Spence have observed, is more poetical than accurate, the bees being always accustomed to fly to their hives in right lines.

In consequence of this peculiarity of insect vision, many of those bees that return homewards

after dusk in the evening, are obliged to lie abroad all night. The same peculiarity, added to the acuteness of their smell, has given birth to various contrivances for inducing bees of different hives to mingle peaceably together, as mentioned at page 154.

From the experiments of Swammerdam, Reaumur, Hooke and others, it seems that bees and other insects, particularly those of the hymenopterous order, possess organs of vision, besides those which are properly called their eyes. These organs, known by the name of STEMMATA, are three smooth, glossy, hemispherical dots, placed in a triangular position upon the vertex or top of the head. The two reticular eyes of one of these insects having been covered with fluid pitch, (the stemmata being left open,) when placed under a glass, the insect ran up and down, but without striking against the sides of the glass. In a similar experiment upon a dragon-fly (*Libellula*), the insect flew away, but in its flight struck against walls and other objects. The stemmata in another insect being covered, and the reticular eyes left open, seemed to cause no impediment to its usual proceedings, it appeared to see as well as before. But when both the stemmata and the eyes were covered, the insect seemed to be totally deprived of sight, it walked slowly under the glass, and when allowed

its liberty, would not venture to fly. These experiments being tried upon bees by Reaumur, they remained immoveable, appearing uncertain where to direct their flight : when their eyes only were covered, they flew perpendicularly upwards till they were out of sight, seeming to follow that direction which the aid of the stemmata afforded them. These stemmata may, from their situation, assist the insect in performing its various operations in the interior of the hive ; may, as Reaumur has observed, answer to them the purpose of microscopes.

I cannot conclude this chapter on the Senses of Bees without noticing the theory of that eminent physiologist DR. VIREY. He has given it as his opinion, that there are seven senses, which he thus divides. Four physical, namely, Touch, Taste, Smell, and Love ; three intellectual, namely, Hearing, Sight, and Thought. (*N. Dict. d'Hist. Nat.*) Whether Love and Thought should be added to my enumeration of the senses of bees I shall not now inquire : if they may be, this work will supply abundant evidence of both, if we comprehend the whole community of bees ; for though physical love appears not to constitute any part of the pleasure of the working bee, (except from some accidental cause which has been already explained,) there is presumptive proof of its

possessing thought or intellect: and although it may not be easy to adduce testimony in favour of the queen's or the drone's possessing thought, they both satisfactorily evince a susceptibility of physical love.

## CHAPTER XXXIII.

## INSTINCTS OF BEES.

ALL creatures, of whatever size, that live together in large communities, have long been observed to display more knowledge and ingenuity than those that do not congregate: this superiority is also supposed to distinguish those which possess the most exquisite sense of touch, and whose occupations require a continued exertion of their powers. The insect tribe strongly confirm the truth of these remarks.

Solitary insects may exhibit a single trait of superiority, either in the catching of their prey, as the spider does; or in the securing of a well protected habitation, as is instanced by the carpenter bee, the mason bee, and some other lone and non-associating insects: but the history of those which unite in societies unfolds more of insect energy and talent. In large communities a combination of exertions is requisite, to procure supplies for the general weal; an intercourse of mutual intelligence is kept up; labour is regularly divided; the sphere of action is extended; and in cases of emergency, there is an unusual manifestation of insect power and intelligence. Instances of all these faculties are eminently conspicuous in

the honey-bee ;—some of them I have before noticed, and shall now advert to a few more.

The mental powers of bees, if I may be allowed to use the term, have been included, by some writers under the general name of Instinct\* ; others, considering the whole of their proceedings to be fraught with intelligence, have regarded them as evidences of a reasoning power. *All* the phænomena of insect life cannot I presume be explained without giving them credit for both.

“ Deem not, vain mortal, that reserv’d for thee  
Hangs all the ripening fruit on reason’s tree ;  
Even these, the tiniest tenants of thy care,  
Claim of that reason, their apportion’d share :  
Witness yon slaughter’d snail, within their door,  
Tomb’d like the first bold Greek on Ilion’s shore.”

EVANS.

A snail having crept into one of *M. Reaumur’s* hives early in the morning, after crawling about for some time, adhered by means of its own slime to one of the glass panes, where, but for the bees, it would probably have remained, till either a

\* Huber has observed that the instinct of the humble-bee is still more *refined* than that of the honey-bee. As an instance of this, he states that the former when unable to penetrate a flower through its natural cavity, makes an aperture at the base of the corolla, or even of the calyx, and insinuates its proboscis into the reservoir of honey, through the opening it has made.

moist air or its own spume had loosened the adhesion. The bees having discovered the snail, immediately surrounded it, and formed a border of propolis round the verge of its shell, which was, at last, so securely fixed to the glass, as to become immoveable, either by the moisture of the air from without, or by the snail's secretion from within.

“ Nor aught avails that in his torpid veins,  
Year after year, life's loitering spark remains\* :  
For ever clos'd the impenetrable door,  
He sinks on death's cold arm to rise no more.”

EVANS.

*Maraldi* has related a somewhat similar instance. A houseless snail or slug, as it is called, had entered one of his hives : the bees, as soon as they observed it, pierced it with their stings, till it expired beneath their repeated strokes ; after which, being unable to dislodge it, they covered it all over with propolis.

“ For, soon in fearless ire, their wonder lost,  
Spring fiercely from the comb th' indignant host,  
Lay the pierc'd monster breathless on the ground,  
And clap, in joy, their victor pinions round.

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\* In the Annual Register for 1775 some very extraordinary instances are related of the protraction of life in snails. After they had lain in a cabinet above fifteen years, immersing them in water caused them to revive and crawl out of their shells.

While all in vain concurrent numbers strive,  
To heave the slime-girt giant from the hive,—  
Sure not alone by force instinctive sway'd,  
But blest with reason's soul-directing aid,  
Alike in man or bee, they haste to pour,  
Thick hardening as it falls, the flaky shower ;  
Embalm'd in shroud of glue the mummy lies,  
No worms invade, no foul miasmas rise." EVANS.

In these two cases, who can withhold his admiration of the ingenuity and judgement of the bees ? *In the first case*, a troublesome creature gained admission into the hive, which, from its unwieldiness, they could not remove, and which, from the impenetrability of its shell, they could not destroy : here then their only resource was to deprive it of loco-motion, and to obviate putrefaction ; both which objects they accomplished most skillfully and securely,—and, as is usual with these sagacious creatures, at the least possible expense of labour and materials. They applied their cement, where alone it was required, namely, round the verge of the shell. *In the latter case*, to obviate the evil of putrescence, by the total exclusion of air, they were obliged to be more lavish in the use of their embalming material, and to form with it so complete an incrustation or case over the "slime-girt giant," as to guard them from the consequences which the atmosphere invariably produces upon all animal substances, that are exposed to its action after life has become

extinct. May it not be asked, What means more effectual could human wisdom have devised, under similar circumstances? Indeed, many of the proceedings of bees and other associated insects seem traceable to a reasoning power; for they exhibit an adaptation of means to ends, and vary them to suit particular emergencies,—the judicious performance of actions with a view to some proposed end, is the criterion by which we judge of rationality.

On the other hand, the difficulty of ascribing some of their actions to any other principle than that which is known by the name of *Instinct*, has led to a classification of the whole of their proceedings under *that* head.

INSTINCT is a faculty the exercise of which implies an exquisitely fine mechanism of some of the senses. It appears to operate independently of all anticipation of consequences; the avenues to knowledge are, to be sure, less circuitous in these and other animals than in man, neither experience nor inductive reasoning seem to be at all essential to the perfection of their operations; they may be said to have, what many an indolent human being has wished to find,—a royal road to knowledge.

“ If in the Insect, Reason’s twilight ray  
Sheds on the darkling mind a doubtful day,  
Plain is the steady light her *Instincts* yield,  
To point the road o’er life’s unvaried field ;

If few those Instincts, to the destin'd goal,  
With surer course, their straiten'd currents roll."

EVANS.

One writer, and that a very ingenious one, has endeavoured to resolve *all* instincts into reason, and has boldly hazarded the following conjecture. "If we were better acquainted with the histories of those insects that are formed into societies,—as the bees, wasps and ants,—we should find that their arts and improvements are not so similar and uniform as they now appear to us, but that they arose in the same manner (from experience and tradition) as the arts of our own species ; though their reasoning is from few ideas, is busied about fewer objects, and is exerted with less energy\*."

Since the Doctor wrote this passage, much light has been thrown upon those very subjects on which he laments our defective knowledge : but whilst it strengthens what I have said as to the possession of reason by insects, it confirms my observations respecting their instinctive powers.

There are facts recorded, in HUBER's *researches respecting ants*, which exhibit in some at least of those insects, (*the Amazons*,) a power of acquiring habits and characters which cannot well be regarded as merely instinctive. The Amazons take advantage of an improvement in their con-

\* Darwin.

dition, and avail themselves of that strength, which sometimes accrues to them, in consequence of a large accession to their numbers. To relieve themselves from labour, they enslave, by a *coup de main*, a feeble colony of ants of another species, and transporting it to their own domicile, impose upon the captives the task of collecting provision, rearing the young, repairing the formicary, &c. &c. The Amazons become a complete aristocracy, and like ladies and gentlemen, have servants to wait upon them.

I shall not attempt to determine the point where intellect begins to dawn, nor to assign the boundary where instinct assumes the characteristics of reason. For it is no where more difficult to discriminate between the regular operation of implanted motives, and the result of acquired knowledge and habits, than in studying the phænomena presented by the bee. For the present therefore I must be allowed to regard the provinces of reason and instinct as undefinable; indeed it seems highly probable that our limited faculties may never enable us to acquire a knowledge of them. Still the facts which I have related, and those which I shall proceed to detail, afford such apparently strong evidences of a reasoning faculty, that without introducing that faculty as their source, I shall be at a loss to explain the phænomena. DR. DARWIN in his *Zoonomia*, relates an anecdote of apparent ra-

tiocination in a *wasp*, which had caught a fly nearly as large as itself. Kneeling down, the Doctor saw the wasp dis sever the head and tail from the trunk of the fly, and attempt to soar with the latter ; but finding when about two feet from the ground that the wings of the fly carried too much sail, and caused its prize and itself to be whirled about, by a little breeze that had arisen, it dropped upon the ground with its prey, and deliberately sawed off with its mandibles, first one wing and then the other : having thus removed these impediments to its progress, the wasp flew away with its booty, and experienced no further molestation from the wind.

Some of the proceedings of bees in glass hives cannot be referred to their instinctive faculties, —glass being a substance which would never be presented to them in their natural state. “Having frequently observed,” says DR. EVANS, “on the inside of my glass hives, prior to the formation of cells, a number of gluey spots ranged at regular distances, I supposed them at first to be intended as a kind of land-marks, pointing out the divisions of the future streets, &c. On re-examination, however, I found them evidently used as so many footstools on the slippery glass, each bee resting on one of these with its middle pair of legs, while the fore-claws were hooked with the hind ones of

the next above ; thus forming a *living* ladder, by which the workers were enabled to reach the top, and pursue their favourite plan of commencing their combs there."

A very striking illustration of the reasoning power of bees occurred to my friend MR. WALOND. Inspecting his bee-boxes at the end of October 1817, he perceived that a centre comb, burthened with honey, had separated from its attachments, and was leaning against another comb, so as to prevent the passage of the bees between them. This accident excited great activity in the colony, but its nature could not be ascertained at the time. At the end of a week, the weather being cold and the bees clustered together, Mr. W. observed, through the window of the box, that they had constructed two horizontal pillars betwixt the combs alluded to, and had removed so much of the honey and wax from the top of each, as to allow the passage of a bee : in about ten days more there was an uninterrupted thoroughfare ; the detached comb at its upper part had been secured by a strong barrier and fastened to the window with the spare wax. This being accomplished, the bees removed the horizontal pillars first constructed, as being of no further use. "During this laborious process," says Mr. W. "the glass window in the box was as warm as I

had felt it during any part of the summer, and the bees were as active within the box."

M. P. HUBER of Lausanne, in his *Observations on Humble-bees*, published in the sixth volume of the Linnæan Transactions, has given a curious detail of some experiments in which the bees conducted themselves somewhat similarly to those of Mr. Walond. Having inclosed twelve humble-bees in a bell-glass, upon a table, he gave them a part of their cones or chrysalids, containing about ten silken cocoons, and freeing the latter as much as possible from wax, he fed the bees for some days with pollen only. The cells containing the cones being very unequal, the mass was so unsteady as extremely to disquiet the bees. Their affection for their young led them to mount upon the cocoons, to impart warmth to the inclosed larvæ: they could not do this without causing the comb to totter or lean on one side, and having no wax for fastening the work to the table, they had recourse to the following ingenious expedient. Two or three bees got upon the comb, and descending to the lower edge of it, with their heads downwards, hung from it by the hooks of their hind feet, and clung to the table by those of the second pair, which are very long; thus did they keep this piece of cell-work steady by their own muscular strength. When fatigued by this

constrained and irksome position, they were relieved by their comrades; even the queen assisted. Having kept the bees in this state till nearly the end of the third day, and shown them to several persons, Huber introduced some honey, to enable them to form wax: they soon constructed pillars, extending from the most projecting parts of the cell-work to the table, and kept the cell-work in a firm position. The wax, however, getting gradually dry, the pillars gave way; when the poor insects adopted their former straining expedient for steadying the comb, and continued, perseveringly, to sustain it in this manner, till Huber took pity on them and glued the cake of comb firmly to the table. Could the most intelligent architect have more judiciously propped a tottering edifice, till adequate supports could be applied?

The resources of bees, when attacked by the *Sphinx Atropos* or *Death's head hawk-moth* are much in point. In this case, according to HUBER, they construct small archways and various other ingenious barricadoes, with a mixture of wax and propolis, so as just to allow the egress and ingress of one or two workers, and effectually to exclude their marauding enemy. The bees do not, as if guided by mere instinct, commence their fortifications on the first attack of the *Sphinx*, nor until they have been robbed of nearly their whole stock

of honey. This therefore seems to be a case in which reason is taught by experience, and which admits in all its particulars of a direct comparison with human reason and human contrivance. Moreover, on the cessation of danger, and when honey-flowers were abundant, the colony prosperous and swarms prepared to issue, these sagacious engineers demolished the fortifications, in order to give room for the exit and entrance of the bees. A colony that had been thus attacked in 1804, and was tardy in its defensive preparations, having derived instruction from the past, constructed fresh ramparts speedily, on the reappearance of the Sphinx in 1807, and thus guarded itself from impending danger.

From what has been said in page 296, it seems probable that the lives of the working bees do not extend beyond a year, at the utmost: if therefore my inference be legitimate, the information of the colony of 1807 must have been traditional, or else derived from a queen which had reigned over them from 1804. On the subject of traditional information, see *Memory of Bees*. It is further remarkable, as a confirmation of this process of ratiocination and reflection, that if the apiarian apply proper guards before the entrances to the hives, when the Sphinx makes its appearance, the bees, finding that they are anticipated, devise no measures of security.

I shall adduce another instance in support of my position that insects are endowed with reason, and that they mutually communicate and receive information. “*A German artist of strict veracity, states, that in his journey through Italy, he was an eye-witness to the following occurrence. He observed a species of *Scarabæus* busily engaged, in making for the reception of its egg a pellet of dung, which when finished, the insect rolled to the summit of a hillock, and repeatedly suffered it to tumble down the slope, apparently for the purpose of consolidating the pellet by the adhesion of earth to it in its rotating motion. During this process, the pellet unluckily fell into a hole, out of which the beetle was unable to extricate it. After several ineffectual attempts, the insect went to an adjoining heap of dung, and soon returned with three companions. All four applied their united strength to the pellet, and at length succeeded in pushing it out, when the three assistant beetles left the spot, and returned to their own quarters\*.*”

MR. HUNTER speaks rather sarcastically, upon the subject of reason being one of the attributes of insects. “Reason,” says he, “has been ascribed to bees; they have been supposed to be legislators, and even mathematicians; and though there is some show of reason for these suppositions, there is

\* Kirby and Spence, vol. ii. p. 522.

much more of imagination." To show how far the excursive fancy of apiarians had sometimes carried them, Mr. H. selected a very unfortunate instance, namely, the assertion, as he calls it, that workers' eggs may be converted into queens,—a fact which has since been established by a series of the most satisfactory experiments. DR. VIREY, in his *Nouvelle Dictionnaire d'Histoire Naturelle*, denies that insects possess any portion of intellect, and attributes all their operations to mere instinct, which he considers as the result of pure mechanism, depending upon the construction of their nervous systems, in the same manner as the tune played upon a barrel organ, is dependent on the notes which the cylinder successively presents to its keys. DES CARTES, and others before him, held a similar opinion, considering insects as being simply susceptible of external impressions, and through the medium of that susceptibility stimulated to act. If this doctrine be correct, instinct is possessed alike by animals and vegetables; in short by every thing that has life, the difference being not in quality, but in quantity.

BUFFON attempted to explain the phænomena of insect life by the simple laws of mechanism, conceding to the insects at the same time a power of distinguishing and choosing between pleasure and pain. Some have even ventured to assert that the invariable exactness of the cell-work of bees is a proof of their stupidity, and "that

the wonders of the honey'd reign," no more bespeak the agency of mind or intellect, than the configuration of salts into their respective crystals.

" Shall then proud sophists arrogant and vain,  
Spurn all the wonders of the honey'd reign,  
And bid alike one mindless influence own  
The social bee, and crystallizing stone?  
Each link they trace in animation's round,  
Dashes their poison'd chalice to the ground." EVANS.

If this theory respecting insects were just, it should elucidate all the phænomena which it undertakes to explain, otherwise it is injurious to science. Examination will prove it to be a mere hypothetical opinion, ingenious, and at first sight plausible, but completely unsatisfactory. This theory is the natural consequence of denying to insects any portion of intellect, and its erroneousness is shown by their capability of instruction. Instinct itself cannot be a purely mechanical process, or it would be incapable of modification, and would, under like circumstances, always act in the same manner. SIR JOSEPH BANKS's *spider* that, on being crippled, changed from a sedentary web-weaver to a hunter, is an instance of modified instinct\*. The well known fact that birds build

\* The account of this spider was sent to *Dr. Leach* by *Sir Joseph Banks*. An interesting history of it is given in the *Linnæan Transactions*, vol. ii. page 393. It had lost five of its legs, which were afterwards reproduced, but the new legs were shorter than those for which they were substituted.

their nests differently, where climate and other circumstances require a variation, is another instance. A *dog* may be restrained from obeying its instincts, by the intimidating recollection of a beating which it had formerly received ; a bee, if alarmed, will quit the nectary of a flower :—here the intellect of the creatures *counteracts their instincts*. There are other instances in which the intellect appears to *direct the instincts*. When the bee makes excursive flights in quest of pasture, its senses serve to guide it, and enable it, by the aid of memory, to retrace its passage home again. At the conclusion of its outward and homeward journeys, its instincts immediately begin to operate ; in the one case, teaching it to imbibe nectar, collect pollen, &c. ; in the other, to store and apply those materials to their respective uses.

M. REIMAR has denied that the lower animals possess *memory*, properly so called ; and has given it as his opinion, that they are only influenced by past events, in consequence of having present objects before them,—never by reflection or knowledge of the past, as being past. But that, with them, a former impression may be renewed, without being recollected ; that it is thus rendered present to the imagination, but has no place in the memory. For arguments and instances in support of their being endowed with memory, see page 260. (Organs of Sensation.)

The possession of the organs of sense implies the possession of some portion of intellect, for without intellect those organs would seem incapable of being employed to the greatest advantage. "There is this difference," says MR. SPENCE, "between intellect in man, and the rest of the animal creation. Their intellect teaches them to follow the lead of their senses, and to make such use of the external world as their appetites or instincts incline them to,—and *this is their wisdom*: while the intellect of man, being associated with an immortal principle, and connected with a world above that which his senses reveal to him, can, by aid derived from heaven, control those senses, and render them obedient to the governing power of his nature; and *this is his wisdom*." A distinction has been made, and very properly, between wisdom and knowledge. The former alone can be possessed by the lower animals, man can possess both. The distinction between them has been very accurately marked by COWPER, though in making it he has confined himself to man only.

"Knowledge and wisdom, far from being one,  
Have oft times no connection. Knowledge dwells  
In heads replete with thoughts of other men,  
Wisdom in minds attentive to their own."

It will, I think, be evident to my readers, from the general tenour of this chapter, that though I

make a distinction between the instinct and the reason of bees, I do not confound their reason with the reason of man. But to obviate all possibility of misconception, I will at once define my meaning, when I use the terms insect reason and instinct.

By *reason*, I mean the power of making deductions from previous experience or observation, and thereby of adapting means to ends. *Instinct* I regard as a disposition and power to perform certain actions in the same uniform manner, without reference either to observation or experience. Those who have attended to this subject, will be aware that *insect reason* as above defined, is more restricted in its functions than *the reason of man* ; to which is superadded the power of distinguishing between the true and the false, and, according to some metaphysicians, between right and wrong. Reason, in man, has a regular growth, and a slow progression ; all the arts he practises evince skill and dexterity, proportioned to the pains which have been taken in acquiring them. In the lower links of creation, but little of this gradual improvement is observable ; their powers carry them almost directly to their object. They are perfect, as BACON says, in all their members and organs from the very beginning.

“ Far different Man, to higher fates assign’d,  
Unfolds with tardier step his Proteus mind,

With numerous Instincts fraught, that lose their force  
Like shallow streams, divided in their course ;  
Long weak, and helpless, on the fostering breast,  
In fond dependence leans the infant guest,  
Till Reason ripens what young impulse taught,  
And builds, on sense, the lofty pile of thought ;  
From earth, sea, air, the quick perceptions rise,  
And swell the mental fabric to the skies." EVANS.

"Every manufacturing art," says DR. REID, "was invented by some one man, successively improved and perfected by others ; and when thus perfected, known only by those to whom it has been taught : while in the arts of animals no individual can claim the invention. Every animal of the species has equal skill from the beginning, without teaching, without experience, or habit."

"Both Instinct and Reason," says DR. EVANS, "appear to lose their intensity, in proportion as their rays diverge from their proper focus ; and as they are less frequently aroused to action. A domesticated fowl is furnished with the same apparatus as her wild sisters on the waste, for rendering her feathers impenetrable to water : yet, living principally under cover, she secretes much less of the oily fluid, destined for that purpose, and makes, when accidentally wet, a most ridiculous appearance. The force of instinctive propensities, when directed to one object, and uninfluenced by reason, is strongly exemplified in the *idiot bee-eater of Selborne*, mentioned by MR.

WHITE, in his *History of Selborne*. The collected powers of reason, when concentrated in a single focus, is no less finely instanced in the immortal NEWTON."

To those readers who have not seen Mr. White's account of the bee-eater, the following abstract of it may prove acceptable.

The boy was a resident in Selborne, about the year 1750. He took great notice of bees from his childhood, and at length used to eat them. In summer, his few faculties were devoted to the pursuit of them, through fields and gardens. During winter, his father's chimney corner was his favourite haunt, where he dozed away his time, in an almost torpid state. Practice made him so expert, that he could seize honey-bees, humble-bees or wasps, with his naked hands, disarm them of their stings, and suck their honey-bags, with perfect impunity. Sometimes he would store the bees in bottles, and even in his shirt bosom. He was the terror of the surrounding bee-keepers, whose gardens he would enter by stealth, and rapping on the outsides of their hives, catch the bees as they came out to see what was the matter. If in this way he could not obtain a sufficient number to supply his wants, so passionately fond was he of honey, that he would sometimes overturn the hives to get at it. He was accustomed to hover about the tubs of the mead-makers, to beg

a draught of bee-wine, as he called it. As he ran about the fields he made a humming noise with his lips, resembling that of bees. The lad was lean in his person, and of a cadaverous unhealthy aspect: he died before he reached the age of maturity.

## CHAPTER XXXIV.

## ON THE ARCHITECTURE OF BEES.

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“ Quel abime aux yeux du sage qu’une ruche d’abeilles !  
Quel sagesse profonde se cache dans cet abime ! Quel  
philosophe osera le fonder ! ”—BONNET.

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THE combs of a bee-hive comprise a congeries of hexagonal cells, formed by the bees, as receptacles for honey or for embryo bees. A honeycomb is allowed to be one of the most striking achievements of insect industry, and an admirable specimen of insect architecture. It has attracted the admiration of the contemplative philosopher in all ages, and awakened speculation not only in the naturalist, but also in the mathematician : so regular, so perfect, is the structure of the cells, that it satisfies every condition of a refined problem in geometry. Still a review of their proceedings will lead to the conclusion, as HUBER has observed, that “ the geometrical relations, which apparently embellish the productions of bees, are rather the necessary result of their mode of proceeding, than the principle by which their labour is guided.” “ We must therefore conclude, that the bees, although they act geometrically, under-

stand neither the rules nor the principles of the arts which they practise so skilfully, and that the geometry is not in the bee, but in the great Geometrician who made the bee, and made all things in number, weight and measure\*."

Before the time of HUBER, no naturalist had seen the commencement of the comb, nor traced the several steps of its progress. After many attempts, he at length succeeded in attaining the desired object, by preventing the bees from forming their usual impenetrable curtain, by suspending themselves from the top of the hive; in short, he obliged them to build upwards, and was thereby enabled, by means of a glass window, to watch every variation and progressive step in the construction of comb.

*Each comb in a hive is composed of two ranges of cells backed against each other: these cells, looking at them as a whole, may be said to have one common base, though no one cell is opposed directly to another. This base or partition between the double row of cells is so disposed as to form a pyramidal cavity at the bottom of each, as will be explained presently. The mouths of the cells, thus ranged on each side of a comb, open into two parallel streets (there being a continued series of combs in every well filled hive). These streets*

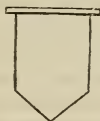
\* Reid.

are sufficiently contracted to avoid waste of room and to preserve a proper warmth, yet *wide enough to allow the passage of two bees abreast*. Apertures through different parts of the combs are reserved to form near roads, for crossing from street to street, whereby much time is saved to the bees.

“ These in firm phalanx ply their twinkling feet,  
Stretch out the ductile mass, and form the street,  
With many a cross-way path and postern gate,  
That shorten to their range the spreading state.”

EVANS.

*The bees*, as has been already observed, *build their cells of an hexangular form, having six equal sides*, with the exception of the first or uppermost row, the shape of which is an irregular pentagon, the roof of the hive forming one of the members of the pentagon, thus :



“ There are only three possible figures of the cells,” says DR. REID, “ which can make them all equal and similar, without any useless interstices. These are the equilateral triangle, the square and the regular hexagon. It is well known to mathematicians that there is not a fourth way possible,

in which a plane may be cut into little spaces that shall be equal, similar, and regular, without leaving any interstices." Of these three geometrical figures, the hexagon most completely unites the prime requisites for insect architecture. The truth of this proposition was perceived by PAPPUS, an eminent Greek philosopher and mathematician, who lived at Alexandria in the reign of Theodosius the Great, and its adoption by bees in the construction of honey-comb was noticed by that ancient geometrician. These requisites are ;

First, *Œconomy of materials*. There are no useless partitions in a honey-comb, each of the six lateral pannels of one cell forms also one of the pannels of an adjoining cell ; and of the three rhombs which form the pyramidal base of a cell, each contributes one-third towards the formation of the bases of three opposing cells, the bottom or centre of every cell resting against the point of union of three pannels that are at the back of it.

Secondly, *Œconomy of room* ; no interstices being left between adjoining cells.

Thirdly, The greatest possible capacity or internal space, consistent with the two former desiderata.

Fourthly, *Œconomy of materials and œconomy of room* produce *œconomy of labour*. And in addition to these advantages, the cells are constructed in the strongest manner possible, considering the

quantity of materials employed. Both the sides and bases are so exquisitely thin, that three or four placed on each other are not thicker than a leaf of common writing-paper; each cell, separately weak, is strengthened by its coincidence with other cells, and *the entrance is fortified with an additional ledge or border of wax*, to prevent its bursting from the struggles of the bee-nymph, or from the ingress and egress of the labourers. This entrance border is *at least three times as thick as the sides of the cell*, and thicker at the angles than elsewhere, which prevents the mouth of the cell from being regularly hexagonal, though the interior is perfectly so.

“ On books deep poring, ye pale sons of toil,  
Who waste in studious trance the midnight oil,  
Say, can ye emulate with all your rules,  
Drawn or from Grecian or from Gothic schools,  
This artless frame? Instinct her simple guide,  
A heaven-taught Insect baffles all your pride.  
Not all yon marshal'd orbs, that ride so high,  
Proclaim more loud a present Deity,  
Than the nice symmetry of these small cells,  
Where on each angle genuine science dwells,  
And joys to mark, through wide creation's reign,  
How close the lessening links of her continued chain.”

EVANS.

I have just adverted to the ingenuity of the bees in thickening, and thereby strengthening the mouths of the cells. *Additional strength is also*

*derived from the bees covering the whole surface of the combs, but more particularly the edges of the cells, with a peculiar kind of varnish, which they collect for the purpose. At first the combs are delicately white, semitransparent, and exceedingly fragile, smooth but unpolished: in a short time their surfaces become stronger, and assume more or less of a yellow tint. The deepening of the colour of honey-combs has been supposed, by some, to be the effect of age; and in part it may be: but it is principally owing to the coat of varnish with which the bees cover them. This varnish strongly resembles propolis, appearing to differ from it only in containing the colouring material which imparts to wax its yellow hue. The source of this colouring matter has not been discovered: it is insoluble in alcohol; but the manufacture of white wax shows that it is destructible by light. —But to return to the construction of the cell-work.*

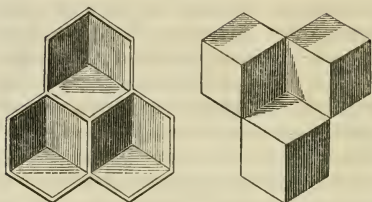
*The pyramidal basis of a cell is formed by the junction of three rhomboidal or lozenge-shaped portions of wax; thus,*



the apex of the pyramid being situated where the three obtuse angles of the lozenges meet. To the exterior edges and angles are attached the six pannels or sides of each cell. The apex of each pyramidal bottom, on one side of a comb, forms the angles of the bases of three cells on the opposite side, the three lozenges respectively concurring in the formation of the bases of the same cells. This will I hope explain what is meant by "each cell separately weak, being strengthened by coincidence with others." The bottom of each cell rests upon three partitions of opposite cells, from which it receives a great accession of strength.

As it is desirable that the reader should thoroughly comprehend this subject, I will restate it in other words.—The partition which separates the two opposing rows of cells, and which occupies, of course, the middle distance between their two surfaces, is not a plane but a collection of rhombs, there being three at the bottom of each cell: the three together form in shape a flattened pyramid, the basis of which is turned towards the mouth of the cell; each cell is in form therefore an hexagonal prism, terminated by a flattened trihedral pyramid, the three sides of which pyramid are rhombs, that meet at the apex by their obtuse angles. The plates underneath, represent the opposite surfaces of the pyramidal bases of adjoining cells, and will, I

trust, enable the reader to understand the foregoing description.



The union of the lozenges in one point, in addition to the support which it is the means of affording to the three partitions between opposing cells, is also admirably adapted to receive the little egg and to concentrate the heat necessary for its incubation.

Each obtuse angle of the lozenges or rhombs forms an angle of about  $110^{\circ}$ , and each acute one, an angle of about  $70^{\circ}$ . M. MARALDI found by mensuration that the angles of these rhombs which compose the base of a cell, amounted to  $109^{\circ} 28'$  and  $70^{\circ} 32'$ ; and the famous mathematician KOENIG, pupil of the celebrated Bernouilli, having been employed for that purpose by M. REAUMUR, has clearly shown, by the method of infinitesimals, that the quantity of these angles, using the least possible wax, in a cell of the same capacity, should contain  $109^{\circ} 26'$  and

70° 34'. This was confirmed by the celebrated MR. M<sup>c</sup>LAURIN, who very justly observes, that the bees do truly construct their cells of the best figure, and with the utmost mathematical exactness.

The construction of several combs is generally going on at the same time. No sooner is the foundation of one laid, with a few rows of cells attached to it, than a second and a third are founded on each side, parallel to the first, and so on, (if the season give encouragement to the operations of the bees,) till the hive is filled with their works; the first constructed comb or combs being always in the most advanced state, and therefore the first to be completed.

*The design of every comb is sketched out, and the first rudiments are laid, by one single bee.* This founder-bee forms a block, out of a rough mass of wax, drawn partly from its own resources, but principally from those of other bees, which furnish materials, in quick succession, from the receptacles under their bellies, taking out the plates of wax with their hind feet, and carrying them to their mouths with their fore feet, where the wax is moistened and masticated, till it becomes soft and ductile.

Thus, "filter'd through yon flutterer's folded mail,  
Clings the cool'd wax, and hardens to a scale.  
Swift, at the well-known call, the ready train  
(For not a buz boon Nature breathes in vain,)

Spring to each falling flake, and bear along  
Their glossy burdens to the builder throng."

EVANS.

The architect-in-chief, who lays, as it were, the first stone of this and each successive edifice, determines the relative position of the combs, and their distances from each other: these foundations serve as guides for the ulterior labours of the wax-working bees, and of those which sculpture the cells, giving them the advantage of the margin and angles already formed.

The expedients resorted to by that ingenious naturalist, HUBER, unfolded the whole process. He saw each bee extract with its hind feet one of the plates of wax from under the scales where they were lodged, and carrying it to the mouth, in a vertical position, turn it round; so that every part of its border was made to pass, in succession, under the cutting edge of the jaws: it was thus soon divided into very small fragments; and a frothy liquor was poured upon it from the tongue, so as to form a perfectly plastic mass. This liquor gave the wax a whiteness and opacity which it did not possess originally, and at the same time rendered it tenacious and ductile. The issuing of this masticated mass from the mouth was, no doubt, what misled Reaumur, and caused him to regard wax as nothing more than digested pollen.

The mass of wax, prepared by the assistants,

is applied by the architect-bee to the roof or bottom of the hive, as the case may be ; and thus a block is raised of a semi-lenticular shape, thick at top and tapering towards the edges. When of sufficient size, a cell is sculptured on one side of it, by the wax-working bees, who relieve one another in succession, sometimes to the number of twenty, before the cell is completely fashioned. At the back and on each side of this first cell, two others are sketched out and excavated. By this proceeding the foundations of two cells are laid, the line betwixt them corresponding with the centre of the opposite cell. As the comb extends, the first excavations are rendered deeper and broader ; and when a pyramidal base is finished, the bees build up walls from its edges, so as to complete, what may be called, the prismatic part of the cell. Every succeeding row of cells is formed by precisely similar steps, until there is sufficient scope for the simultaneous employment of many workers.

“ These, with sharp sickle, or with sharper tooth,  
Pare each excrescence, and each angle smooth,  
Till now, in finish'd pride, two radiant rows,  
Of snow-white cells, one mutual base disclose.  
Six shining pannels gird each polish'd round,  
The door's fine rim, with waxen fillet bound,  
While walls so thin, with sister walls combin'd,  
Weak in themselves, a sure dependence find.”

EVANS.

The pyramidal bases and lateral plates are

successively formed, with surprising rapidity : the latter are lengthened as the comb proceeds, for the original semi-lenticular form is preserved till towards the last, when if the hive or box be filled, the sides of all the cells receive such additions as give them equal depth.

*The cells intended for the drones* are considerably larger, and more substantial, than those for the working bees, and, being later formed, usually appear near the bottom of the combs. Last of all are built the *royal cells*, the cradles of the infant queens : of these there are usually three or four, and sometimes ten or twelve, in a hive, attached commonly to the central part, but not unfrequently to the edge or side of the comb. MR. HUNTER says that he has seen as many as thirteen royal cells in a hive, and that they have very little wax in their composition, not one-third, the rest he conceives to be farina. Such is the genuine loyalty of bees, that the wax which they employ with so much geometric œconomy, in the construction of hexagonal cells, is profusely expended on the mansions of the royal bee-nymph, one of these exceeding in weight a hundred of the former. They are not interwoven with them, but suspended perpendicularly, their sides being nearly parallel to the mouths of the common cells, several of which are sacrificed to support them.

“ No more with wary thriftiness imprest,  
They grace with lavish pomp their royal guest,

Nor heed the wasted wax, nor rifted cell,  
To bid, with fretted round, th' imperial palace swell."

EVANS.

The form of these royal cells is an oblong spheroid, tapering gradually downwards, and having the exterior full of holes, somewhat resembling the *rustic* work of stone buildings. The mouth of the cell, which is always at its bottom, remains open till the maggot is ready for transformation, and is then closed as the others are.

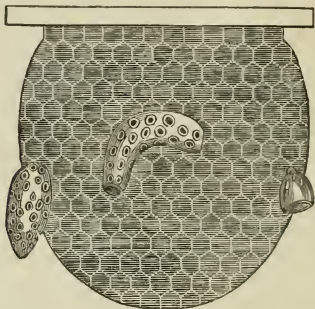
Immediately on the emergence of a ripened queen, the lodge which she inhabited is destroyed, and its place is supplied by a range of common cells. The site of this range may always be traced, by that part of the comb being thicker than the rest, and forming a kind of knot; sometimes the upper portion of the cell itself remains, like an inverted acorn-cup, suspended by its short peduncle.

" Yet no fond dupes to slavish zeal resign'd,  
They link with industry the loyal mind.  
Flown is each vagrant chief? They raze the dome,  
'That bent oppressive o'er the fetter'd comb,  
And on its knotted base fresh garners raise,  
Where toil secure her well-earn'd treasure lays."

EVANS.

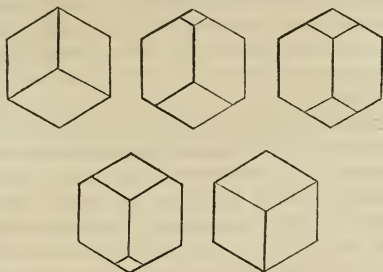
In this mutilated state only, and not in the breeding season, could Mr. Hunter have seen this cradle of royalty; for he describes it as the half of an oval, too wide and shallow to receive its

supposed tenant. The following sketch affords a representation of the hexagonal cells of a comb, and also the attachment of the royal cradles.



I have spoken of the perfect regularity in the cell-work of a honey-comb ;—particular circumstances, however, induce a departure from this exactness: for instance, where bees have commenced a comb with small cell-work, and afterwards wish to attach to it a set of large cells, as in the case of drone-cells being required to be appended to workers-cells. These deviations from the usual regularity renew our admiration of bee-ingenuity, though Reaumur and Bonnet have regarded them as examples of imperfection. They effect their object by interposing three or four series of, what may be called, *cells of transi-*

*tion*, the bottoms or bases of which are composed of two rhombs and two hexagons, instead of three rhombs; the rhombs and hexagons gradually varying in form and relative proportion, till the requisite size, namely that of the cells which they are approaching, has been attained. The following outlines will serve to convey to the reader the regular steps in this progressive increase.



The same gradation is observed when returning to smaller cells. Every apparent irregularity is therefore determined by a sufficient motive, and forms no impeachment of the sagacity of the bee.

The common breeding-cells of drones or workers are, occasionally, (after being cleaned,) made the depositories of honey; but the cells are never made so clean, as to preserve the honey undeteriorated.

The finest honey is stored in new cells, constructed for the purpose of receiving it, their configuration resembling precisely the common breeding-cells : these *honey-cells vary in size*, being made more or less capacious, *according to the productiveness of the sources from which the bees are collecting*, and *according to the season of the year* : the cells formed in July and August vary in their dimensions from those that are formed earlier ; being intended for honey only, they are larger and deeper, the texture of their walls is thinner, and they have more dip or inclination : this dip diminishes the risk of the honey's running out, which from the heat of the weather, and the consequent thinness of the honey, at this season of the year, it might otherwise be liable to do. *When the cells, intended for holding the winter's provision, are filled, they are always closed with waxen lids*, and never re-opened till the whole of the honey in the unfilled cells has been expended. The waxen lids are thus formed ;—The bees first construct a ring of wax within the verge of the cell, to which other rings are successively added, till the aperture of the cell is finally closed with a lid composed of concentric circles.

The brood-cells, when their tenants have attained a certain age, are also covered with waxen lids, like the honey-cells ; the lids differ a little, the latter being somewhat concave, the former

convex. *The depth of the brood-cells* of drones and working bees is about half an inch; *their diameter* is more exact, that of the drone-cells being  $3\frac{1}{3}$  lines \*, that of the workers  $2\frac{3}{5}$  lines. These, says Reaumur, are the invariable dimensions of all the cells, that ever were, or ever will be made.

From this uniform, unvarying diameter of the brood-cells, when completed, their use has been suggested, as an universal standard of measure, which would be understood, in all countries, to the end of time.

“ While heav’n-born Instinct bounds their measur’d view,  
From age to age, from Zembla to Peru,  
Their snow-white cells, the order’d artists frame,  
In size, in form, in symmetry the same.”      EVANS.

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\* A line is the twelfth part of an inch.

## CHAPTER XXXV.

AN INQUIRY INTO THE SOURCE AND  
NATURE OF BEES-WAX.

It has long been very generally and implicitly believed, that the yellow matter (in other words, the pollen or farina of flowers,) which bees visibly collect upon their thighs, is the prime constituent of wax, the material of the honey-comb. Even BONNET and REAUMUR were of this opinion. BUTLER, PURCHAS, RUSDEN and THORLEY have argued against its identity with wax; and I trust that the observations and experiments which I am about to detail, will convince the dispassionate inquirer of the fallacy of this old opinion.

In the first place, It is to be observed, that where no more comb can be built, as in old hives, the bees carry in the greatest quantity of this yellow matter.

Secondly, That it differs materially from wax, the latter when examined between the fingers being adhesive, the former crumbly; the latter also liquefying on the application of heat, whilst the former burns to ashes.

Thirdly, That the wax of new combs, from whatever source collected, is uniformly white; whereas the farina, as gathered by the bees, is

always black, yellow, or red, agreeing in colour with the anther dust of the flowers in blossom at the time of its collection. Moreover, the farina, after it has been stored in the cells, retains its original colour, whilst wax invariably changes, first to a yellow, and lastly to a blackish tint. Layers of different-coloured farina are generally found in the cells, if slit down; and every hive, at the season of deprivation, possesses a store of it.

Fourthly, That fresh colonies carry in very little, if any, of this matter, for some days after swarming, though combs are formed within that period. I noticed this fact in my first colony: the swarm issued from the parent hive on the 18th of May;—five days of rainy weather succeeded: during this period the bees were prevented from flying abroad; I fed them nightly with sugared ale, and before the return of fine weather a considerable quantity of comb was formed. Now excepting such materials as the bees might have brought with them from the parent hive, in this case, the sugared ale alone must have been the source of the wax. HUISEN has remarked that unless bees have access to water, and also to sugar or honey, no comb can be formed. Again, it may be observed, that upon the storifying plan, when fresh works are commenced in the duplets or triplets, if the farina

were the basis of the combs, an increased quantity should be carried in. On the contrary, though I have watched the bees very minutely on these occasions, I scarcely ever witnessed the introduction of farina ; and in such rare instances as I did observe it, it might fairly be regarded as food for the young larvæ of the bees contained in the full box or boxes.

“ No pearly loads they bear ; but o’er the field  
Round flower and fruit the lithe proboscis wield,  
From meal-tipp’d anthers steal the lacquer’d crown,  
And brush from riind or leaf the silvery down.  
Nay oft, when threaten’d storms or drizzling rain,  
Close in their walls, th’ impatient hosts detain,  
E’en from the yellow hoard’s nectareous rill,  
Their tubes secerning can a stream distil,  
Clear and untinctur’d as the fountain wave,  
That glides, slow trickling, thro’ the crevic’d cave.  
But, as that welling wave, around the stone,  
In rings concentric, wreathes its sparry zone,  
So filter’d thro’ yon flutterer’s folded mail,  
Clings the cool’d wax, and hardens to a scale.”

EVANS.

The observations of MR. JOHN HUNTER tended to confirm this view of the matter ; still more so, those of M. HUBER and SON. In order to determine the point with greater precision, Huber instituted many experiments. He lodged a recent swarm in a straw hive, leaving at its disposal only a sufficiency of honey and water for its consumption, and preventing it from going beyond the

precincts of a room, so closed as to admit only a renewal of the air. At the end of five days as many cakes of beautifully white, though very fragile wax, were suspended from the roof; the honey had totally disappeared. Still however, as there was a possibility that the thighs and stomachs of the bees might have conveyed pollen from the parent hive, he withdrew these five combs, and replaced the bees in the hive with a fresh supply of honey and water; they renewed their toil with unabated industry, and soon fabricated new combs: these last were taken from them; when the patient and indefatigable insects commenced a third structure of comb. Five times in succession were their works thus completed and removed, although during the whole of this period they were fed merely with honey and water, and could not possibly have had access to farina.

These experiments, so uniform in their results, give indubitable validity to the fact,—that honey, through the organic intervention of bees, may be converted into wax. A contrary experiment was made, by abundantly supplying a hive with fruit and pollen only: but during eight days confinement the bees produced no wax whatever, nor exhibited any plates under their abdominal rings; no combs were formed, nor was an atom of farina touched,—a clear proof that farina supplies neither

wax nor sustenance to adult bees. The improbability of this indeed is evinced by its abundance in hives whose tenants have died of famine. And as to its being the constituent of wax, REAUMUR calculated that a well stocked hive might collect at least 100 pounds of pollen in a season, whereas the weight of wax fabricated in the same time would not exceed two pounds.

Experiments have proved the excellence of sugar as a substitute for honey, and in some instances its superiority for the formation of wax. It might otherwise have been supposed that bees might form comb from some particles of wax accidentally present in the honey, and that these afforded the pabulum for this secretion. To prove therefore that the saccharine principle alone enabled the bees to produce wax, being still confined, they were supplied with a syrup made with Canary-sugar and water, and at the same time comparative experiments were made in another hive, where the bees were fed on honey and water. The syrup-fed bees produced wax sooner and more abundantly than the honey-fed bees. Another fact was also incontrovertibly elicited; namely, that in the old hives the honey is warehoused, and that in the new ones it is consumed and transmuted into wax.

The experiments of HUBER have been confirmed by those of M. BLONDELU, of Noyau,

who addressed a memoir upon this subject to the Society of Agriculture at Paris, in May 1812. HUISH has critically examined these experiments of Huber, but without being convinced by them: for having observed pollen on the thighs of bees when swarming, and upon dissection, in their stomachs also, he considers that pollen, elaborated in the second stomach of the bee, "contains in itself the principle of wax." Were this the case, what a store of pollen must the bees have reserved, in Huber's experiments, wherein they formed five successive sets of comb, without access to fresh pollen! The pollen or bee-bread, which Huish discovered on the thighs and in the stomachs of some of his bees, was most likely intended for larva-food; they were probably bees that had been abroad, and joined the swarm on their passage home, before they had deposited their freight in the parent hive. With this pollen (or ambrosia, as it has been called), after conversion into a sort of whitish jelly by the action of the bee's stomach, where it is probably mixed with honey, and then regurgitated, the young brood, immediately upon their exclusion and until their change into nymphs, are fed by the nursing-bees several times a day. The opinion that pollen is the prime constituent of wax was held by BUFFON, and remains uncontradicted in an edition of his Works so late as 1821. ARTHUR

DOBBS, Esq., in the Philosophical Transactions for 1752, instead of considering wax as digested pollen discharged from the stomach of the bee, regards it as being emitted *per anum*; and as he speaks of its discharge in husks or shells, doubtless he saw it in that form, which it is now known to assume when moulded upon the body of the bee. Indeed he says that he has had swarming bees alight upon his hand, and drop warm wax upon it. Its being secreted only by the under side of the belly might easily deceive, and lead him to regard it as alvine excrement.

I will here subjoin some more proofs of the non-identity of wax and pollen. So long ago as 1768, the LUSATIAN SOCIETY (called *Société des Abeilles*, founded at little Bautzen, a village in Upper Lusatia, under the auspices of the Elector of Saxony,) knew that wax was not discharged from the mouths of bees, but was secreted in thin scales among their abdominal rings or segments. About 1774, MR. THORLEY caught a bee just entering its hive, and found, among the plaits of its belly, no less than six pieces or scales of solid wax, perfectly white and transparent, and he oftentimes saw wax in the same situation. M. DUCHET, in his *Culture des Abeilles*, quoted by WILDMAN in 1778, declares that wax is formed of honey; and relates in proof of it, that he has seen a broken comb of an upset hive, which

was repaired during bad weather, when the bees could not acquire any other material. This statement of Duchet corresponds with my own observation, as stated in page 357, but is not so conclusive. In Duchet's instance there might have been other materials in the hive besides honey; whereas in my case the bees had access to no materials whatever, excepting the sugared ale and the honey which they had conveyed from the parent hive, the swarm having been just hived. WILDMAN, in his Treatise on the Management of Bees, states his having seen pieces of wax, like fish scales, on the hive floor of a fresh swarmed colony, part of which he thinks must at least have been formed upon the body of the bee; some flakes might have fallen from the combs then constructing, but there were many pieces among them which were concave on one side and convex on the other, as if moulded on the insect's belly. Flakes were likewise seen, hanging loose, between the abdominal scales of the bees. In 1792, MR. JOHN HUNTER, apparently unacquainted with antecedent conjectures, detected the genuine reservoir of wax under the bee's belly. He considered wax as an external secretion of oil, formed and moulded between the abdominal scales of the insect. DR. EVANS confirms the testimony of Wildman and Hunter, having been an eye-witness to the formation of wax into

flakes. "One or more bees," he remarks, "may be often seen before the door of the hive, supporting themselves by their two fore feet, fluttering their wings, and agitating the hind parts of their bodies. They are then evidently moulding the wax between their abdominal scales, the motion of the wings serving to preserve their balance, and as a signal for their companions within to come and carry off the falling flakes." In the *Philosophical Transactions* for 1807, MR. KNIGHT states that there is no such secretory process; that the wax is laid on the scales of the abdomen for the convenience of carriage, and to receive warmth preparatory to cell-building.

To complete the evidence however, to me so irresistible, in favour of the wax-secreting faculty of the bee's body, I observe finally, that in 1793, M. Huber's observations led him to the same conclusion as Mr. Hunter's, relative to the nature of the laminae under the abdominal scales: but Huber slumbered not there, he prosecuted the inquiry more successfully than any preceding naturalist, and at length demonstrated the secreting organs which had eluded the scrutiny of Swammerdam, Hunter, and other acute anatomists. He found that these laminae were contained in distinct receptacles, on each side of the middle process of the scales; he examined with great care the form and structure of these se-

creting cavities, which are peculiar to working bees. Each working bee has eight of these organs, sacklets or small compartments. Their general shape is an irregular pentagon, and the plates of wax, being moulded in them, exhibit accordingly the same form. A perforation of their lining membrane on the side next to the abdomen, started a jet of transparent fluid, which congealed on cooling; in this state it resembled wax, and became again fluid on the application of heat. Comparative experiments were made with the substance contained in the pouches and with the wax of fresh combs: a great similarity between these two substances was discerned; the latter appeared somewhat more compound, having probably received some additional ingredient, while employed as the material for building. The secreting function of the membrane on the inner surface of these cavities, was further evinced, by a more minute examination of its structure, which exhibited a number of folds, forming an hexagonal net-work, analogous to the inner coat of the second stomach of ruminating quadrupeds. Huber does not appear to have known the observations either of Duchet or of Wildman on this subject, although they were made long prior to Mr. Hunter's; for he quotes only from the latter.

When combs are wanted, bees fill their crops

with honey, and retaining it in them, hang together in a cluster from the top of the hive, and remain inactive about twenty-four hours. During this time the wax is secreted, and may be seen in laminæ, under the abdominal scales, whence it is removed by the hind legs of the bee, and transferred to the fore legs; from them it is taken by the jaws, and after being masticated as described in Chap. xxxiv, page 347, the fabrication of comb commences.

“To see the wax-pockets in the hive-bee, you must press the abdomen, so as to cause its distention; you will then find, on each of the four intermediate ventral segments, separated by the carina or elevated central part, two trapeziform whitish pockets, of a soft membranaceous texture: on these the laminæ of wax are formed, in different states, more or less perceptible\*.”

MESSRS. HUBER and SON ascertained that the office of collecting honey, for the elaboration of wax, is filled by a particular description of bees or labourers, to which they have given the name of *wax-workers*. These bees are susceptible of an increase in size, as is evident from the state of their stomachs, when quite full of honey. Dissection has shown that their stomachs are more capacious than those of the bees that are differ-

\* Kirby and Spence.

ently occupied. Bees not possessed of this expanding stomach, gather no more honey than is necessary to supply the immediate wants of themselves and their companions, with whom they readily share it: these are called *nursing-bees*, their principal duty being to attend the eggs and larvæ. The task of storing the hive with provisions devolves upon the wax-workers, who, when not occupied in the construction of comb, disgorge their honey into those cells which are intended for its reception. By marking the bees, it was found that they never encroached upon each other's employment: this strict adjustment of duty is the more remarkable, since the power of producing wax is common both to the nursing- and wax-working bees, a small quantity of wax being really found in the receptacles of the nursing-bees.

In the foregoing experiments for ascertaining the sources of wax, the bees had borne their confinement without evincing the least impatience; but on another occasion, when shut up with a brood of eggs and larvæ, and without pollen, though honey was copiously supplied, they manifested uneasiness and rage at their imprisonment. Fearing the consequence of this state of tumult being prolonged, Huber allowed them to escape in the evening, when too late to collect provisions;

the bees soon returned home. At the end of five days, during which this experiment was tried, the hive was examined :—the larvæ had perished, and the jelly that surrounded them on their introduction into the hive had disappeared. The same bees were then supplied with a fresh brood, together with some comb containing pollen : very different indeed was their behaviour with this outfit ; they eagerly seized the pollen and conveyed it to the young ; order and prosperity were re-established in the colony ; the larvæ underwent the usual transformations ; royal cells were completed and closed with wax, and the bees showed no desire to quit their habitation. These experiments afford indisputable evidence of the origin of wax and the destination of pollen.

Though the wax of honey and brood-comb be an original secretion from the body of the bee, wax is also considered by some as a vegetable substance existing abundantly in nature. According to PROUST, it forms the silvery down on the leaves, flowers and fruit of many plants, and resides likewise in the feculæ of others. DR. DARWIN, in his *Phytologia*, supposes that wax is secreted to glaze over the fecundating dust of the anthers, and prevent its premature explosion from excessive moisture : to an unseasonable dispersion of anther-dust he ascribes the failure

of orchard and corn crops in summers of extreme humidity. The wax-tree of Louisiana\* (*Myrica cerifera*) contains immense quantities of wax. In this respect there appears an identity betwixt animal and vegetable secretion, which may be viewed as indicative of simplicity in the structure of the bee: a still simpler organization exists in the aphis, which extracts the saccharine juices from the leaves and bark of trees, and expels them again nearly unchanged†.

\* *Vide* Part I. Chap. 28.

† *Vide* Part I. Chap. 5

## CHAPTER XXXVI.

## POLLEN.

*POLLEN* and *Farina*, in the language of Botanists, are terms applied to the powdery particles discharged by the anthers of flowers in warm dry weather, and which hang about the stamina. The colour, as well as the structure of pollen, varies in different plants. Its use, in fecundating the germens of flowers, is well known: the services of bees, towards that end, will be noticed in a separate chapter. The sixth volume of the Linnean Transactions contains an interesting paper upon this substance, from the pen of MR. LUKE HOWARD.

*Pollen* has a capsular structure, varying its shape in different flowers, insomuch as to be a popular object for the microscope. Each grain consists commonly of a membranous bag, which, when it has come to maturity, bursts on the application of moisture: this bursting is naturally effected by the honey-like exudation of the stigma; but if extraneous moisture accomplish it prematurely, the pollen is rendered useless for the purpose of fructification. Whenever moistened, the bag explodes with great force, and discharges a subtile vapour or essence, which, when released

by the peculiar moisture of the stigma, performs effectually its final purpose.

This substance was once erroneously supposed to be the prime constituent of wax; but the experiments of HUNTER and HUBER have proved that wax is a secretion from the bodies of wax-working bees\*, and that the principal purpose of pollen is to nourish the embryo-bees; (it has been called the ambrosia of the hive). Huber was the first who suggested this idea, and it well accords with what we observe among other parts of the animal kingdom;—birds, for instance, feed their young with different food from what they take themselves. Mr. Hunter examined the stomachs of the maggot-bees, and found farina in all, but not a particle of honey in any of them. Huber considers the pollen as undergoing a peculiar elaboration in the stomachs of the nursing-bees, to be fitted for the nutriment of the larvæ.

“In spring,” says DR. EVANS, “which may be called the bee’s first *carrying* season, scarcely one of the labourers is seen returning to the hive, without a little ball or pellet of farina, on each of its hinder legs. These balls are invariably of the same colour as the anther-dust of the flowers then in bloom, the different tints of yellow, as pale, greenish or deep orange, being most prevalent.”

\* *Vide* Chap. XXXV.

The bees may frequently be observed to roll their bodies on the flower, and then, brushing off the pollen which adheres to them, with their feet, form it into two masses, which they dispose of in the usual way. In very dry weather, when probably the particles of pollen cannot be made to cohere, I have often seen them return home so completely enveloped by it, as to give them the appearance of a different species of bee. The anther-dust, thus collected, is conveyed to the interior of the hive, and there brushed off by the collector or her companions. REAUMUR and others have observed, that *bees prefer the morning for collecting this substance*, most probably that the dew may assist them in the moulding of their little balls. "I have seen them abroad," says Reaumur, "gathering farina before it was light ;" they continue thus occupied till about ten o'clock.

"Brush'd from each anther's crown, the mealy gold,  
With morning dew, the light fang'd artists mould,  
Fill with the foodful load their hollow'd thigh,  
And to their nurslings bear the rich supply." EVANS.

This is their practice during the warmer months ; but in April and May, and at the settlement of a recent swarm, they carry pollen throughout the day ; but even in these instances, the collection is made in places most likely to furnish the requisite moisture for moulding the pellets, namely, in shady and sometimes in very distant places.

When a bee has completed her loading, she returns to the hive, *part* of her cargo *is instantly devoured* by the nursing-bees, to be regurgitated for the use of the larvæ, and *another part is stored* in cells for future exigencies, *in the following manner*. The bee, while seeking a fit cell for her freight, makes a noise with her wings, as if to summon her fellow-citizens round her; she then fixes her two middle and her two hind legs upon the edge of the cell which she has selected, and curving her body, seizes the farina with her fore legs, and makes it drop into the cell: thus freed from her burthen, she hurries off to collect again. Another bee immediately packs the pollen, and kneads and works it down into the bottom of the cell, probably mixing a little honey with it, judging from the moist state in which she leaves it; an air-tight coating of varnish finishes this storing of pollen.

From the uniform colour of each collection, it is reasonable to suppose that *the bee never visits more than one species of flower on the same journey*; this was the opinion of ARISTOTLE, and the generality of modern observers have confirmed it. REAUMUR, however, supposed that the bee ranged from flowers of one species to those of another indiscriminately. MR. ARTHUR DOBBS, in the Philosophical Transactions for 1752, states that he has repeatedly followed bees when collecting

pollen ; and that whatever flowers they first alighted upon decided their choice for that excursion, all other species being passed over unregarded : BUTLER had previously asserted the same thing. Here we see the operation of a discriminating instinct, which in the first place leads the insect to make an aggregation of homogeneous particles, which of course form the closest cohesion ; and in the next place prevents the multiplication of hybrid plants. This remark was made by SPRENGEL, who has confirmed the observations of Dobbs, Butler, and others. The bees, which Reaumur observed to visit flowers of different species, might have been in quest of honey as well as of pollen.

## CHAPTER XXXVII.

## PROPOLIS.

BESIDES the honey and pollen which are gathered by bees, they collect a resinous substance, that is very tenacious, semitransparent, and which gives out a balsamic odour, somewhat resembling that of storax. In the mass, it is of a reddish brown colour; when broken, its colour approaches that of wax. Dissolved in spirit of wine or oil of turpentine, it imparts, as varnish, a golden colour to silver, tin, and other white polished metals. Being supposed to possess medicinal virtue, it was formerly kept in the shop of the apothecary. According to Vauquelin, propolis consists of one part of wax and four of pure resin; in which respect, and in its yielding the same acid, (the *benzoic*,) it resembles balsam Peru. It also contains some aromatic principles.

With propolis, bees attach the combs to the roof and sides of their dwelling, stop crevices, fasten the hives or boxes to the floors and roofs, strengthen the weak places of their domicile, and varnish the cell-work of their combs. The chapter on Instincts details the modes in which bees employ it for their protection against intruders into their

hives. From its being used for the firm attachment of combs to the roofs of hives, it must be the first matter collected by a recent swarm. The term Propolis is derived from the Greek, and signifies 'before the city,' bees having been observed to make use of it, in strengthening the outworks of their city.

Reaumur was unable to discover its vegetable source. It is generally supposed to be gathered from the resinous exudations of the poplar, alder, birch, and willow ; according to Riem, from pines and other trees of the fir tribe ; though some authors have alleged that bees can produce it where no such trees are near them, and that turpentine and other resins have been disregarded when laid before them. A recent experiment of Huber has solved this question : he planted in spring some branches of the wild poplar, before the leaves were developed, and placed them in pots near his apiary : the bees alighting on them separated the folds of the largest buds with their forceps, extracted the varnish in threads, and loaded with it, first one thigh and then the other ; for they convey it like pollen, transferring it by the first pair of legs to the second, by which it is lodged in the hollow of the third. Huber examined the chemical properties of this varnish, and identified it with the propolis which fastens the combs to the hives.

With respect to the absence of fir-trees, &c. in the neighbourhood of the hives, it is to be recollected, in the first place, that *bees will fly about three miles* (some say five,) for what they may want: HUBER *thinks that the radius of the circle they traverse does not exceed half a league*, yet says that the question is undecided. In the second place, that a balsamic and tenacious secretion is found upon the buds of several plants and trees, which are often crowded with these insects; such for instance as the tacamahac, horse-chesnut, and hollyhock. Dr. Evans says that he has been an eye-witness of their collecting the balsamic varnish which coats the young blossom buds of the hollyhock, and has seen them rest at least ten minutes on the same bud, moulding the balsam with their fore feet and transferring it to the hinder legs, as above stated. When finally moulded, the pellets of propolis are of a lenticular form.

“ With merry hum the Willow’s copse they scale,  
The fir’s dark pyramid, or Poplar pale,  
Scoop from the Alder’s leaf its oozy flood,  
Or strip the Chesnut’s resin-coated bud,  
Skim the light tear that tips Narcissus’ ray,  
Or round the Hollyhock’s hoar fragrance play.  
Soon temper’d to their will through eve’s low beam,  
And link’d in airy bands the viscous stream,  
They waft their nut-brown loads exulting home,  
That form a fret-work for the future comb,  
Caulk every chink where rushing winds may roar,  
And seal their circling ramparts to the floor.” EVANS.

As to the bees refusing resinous substances, when presented to them, as substitutes for propolis, MR. KNIGHT has assured us, in the *Philosophical Transactions*, that this is not the fact; as he had seen them carry off a composition of wax and turpentine, which had been laid over the decorticated parts of his trees.

The bees blend this substance with wax in different proportions, as occasion may require. Among the ancients, it bore different names, according to the quantity of wax it contained. VIRGIL made this distinction, though MR. MARTIN conceives that his *narcissi lachrymæ*, *cera* [cum quâ] —“*spiramenta tenuia linunt*,”—and *gluten*, all mean the same thing: this is probably a mistake. It seems much more likely that VIRGIL should mean *metys*, *pissoceron* and *propolis*, the three names by which PLINY says that the varieties of propolis were distinguished in his time.

I have before alluded to the fortification of the weak places of hives with propolis. M. Reaumur, whose hives consisted of wooden frames and panes of glass, wishing to put this talent of the bees to the test, carelessly fastened the glass of a hive with paper and paste, before putting in a swarm; the bees soon discovered the weakness of his paste-work, and indignantly gnawing to pieces this feeble fence, secured the glass with their own cement.

I have already observed, that *the sage bee* chooses the morning for collecting pollen, on account of the dew's enabling her to compress it better ; but, as moisture would render propolis less coherent, she *gathers this substance when the day is somewhat advanced*, and when the warmth of the sun has imparted to it softness and pliancy. These qualities are however soon lost, after it has been detached from the secreting surfaces, and exposed to the oxygenizing power of the air. So rapid is this hardening process, that the bees which store it, oftentimes find some difficulty in tearing it with their jaws from the thighs of its collectors.

## CHAPTER XXXVIII.

## IMPORTANCE OF BEES TO THE FRUCTIFICATION OF FLOWERS.

HONEY is regarded by modern naturalists as of no other use to plants but to allure insects, which, by visiting the nectaries of their flowers to procure it, become instrumental to their fertilization, either by scattering the dust of the stamens upon the stigmata of the same flower, or by carrying it from those which produce only male blossoms to those that bear female ones, and thereby rendering the latter fertile.

No class of insects renders so much service in this way as *bees*; they *have however been accused of injuring vegetables*, in three ways: 1st, by purloining for their combs the wax which defends the prolific dust of the anthers from rain; 2ndly, by carrying off the dust itself, as food for their young larvæ; and 3dly, by devouring the honey of the nectaries, intended to nourish the vegetable organs of fructification\*.

In defence of his insect protégées, DR. EVANS has observed:

“First, That the proportion of wax collected

\* Darwin's *Phytologia*.

from the anthers is probably very trifling, it being so readily and abundantly obtainable from honey.

“Secondly, That for any depredations committed on the farina, they amply compensate, by their inadvertent yet providential conveyance of it, on their limbs and corslets, to the female organs of monoecious or dioecious plants ; whose impregnation must otherwise have depended on the uncertain winds. This is exemplified in the practice of our gardeners, who in early spring, before they dare expose their hotbeds to the open air, and consequently to the access of insects, insure the fertility of the cucumbers and melons, by shaking a male blossom over each female flower. For the same purpose, and with the same success, a gentleman in Shropshire substitutes a male blossom, in place of the female one, at the top of his embryo cucumber, which instantly adheres, and falls off in due time. To the same kind intrusion of insects we owe the numberless new sorts of esculents and endless varieties of flowers in the parterre :

‘ Where Beauty plays  
Her idle freaks ; from family diffus’d  
To family, as flies the father dust  
The varied colours run.’ THOMSON.

“Thirdly, That in a great many instances, the honey-cups are completely beyond the reach of the fructifying organs, and cannot possibly be

subservient to their use. Hence SIR J. E. SMITH *believes the honey to be intended, by its scent, to allure these venial panders to the flowers*, and thereby shows how highly he estimates their value to vegetation. See his Introduction to Botany. In the same work, the author observes that SPRENGEL has ingeniously demonstrated, in some hundreds of instances, how the corolla serves as an attraction to insects, indicating by various marks, sometimes perhaps by its scent, where they may find honey, and accommodating them with a convenient resting-place or shelter while they extract it. This elegant and ingenious theory receives confirmation from almost every flower we examine. Proud man is disposed to think that

‘ Full many a flower is born to blush unseen,’

because he has not deigned to explore it ; but we find that even the beauties of the most sequestered wilderness are not made in vain. They have myriads of admirers, attracted by their charms, and rewarded by their treasures, which would be as useless as the gold of a miser, to the plant itself, were they not the means of bringing insects about it.”

Thus the bee, by settling upon and collecting honey from a thousand different flowers, is thereby assisting the great purpose of vegetable reproduction, at the same time that the loads she

carries home enable her to construct receptacles for the reproduction of her own race.

“For the due fertilization of the common *Barberry*, it is necessary that its irritable stamens should be brought into contact with the pistil, by the application of some stimulus to the base of the filament; but this would never take place were not insects attracted, by the melliferous glands of the flower, to insinuate themselves amongst the filaments, and thus, while seeking their own food, unknowingly to fulfil the intentions of Nature in another department.” *In some cases the agency of the hive-bee is inadequate to produce the required end; in these the humble-bee is the operator*: these alone, as Sprengel has observed, are strong enough for instance, to force their way beneath the style-flag of the *Iris Xiphium*, which in consequence is often barren. *Other insects besides bees are instrumental in producing the same ends*; indeed they are necessary instruments: and hence according to the same naturalist, in some places, where the particular insect required is not to be met with, no fruit is formed upon the plant which is usually visited by it, where it is indigenous; for he supposes that *some plants have particular insects appropriated to them*. The American *Aristolochia Sipho*, though it flowers plentifully, never forms fruit in our gardens, probably for the reason just assigned. The *Date Palm* affords a

striking instance of the necessity of extraneous intervention to perfect fructification; male and female flowers are borne on separate trees, and unless the two sorts be in the neighbourhood of each other, the fruit has no kernel and is not proper for food. There was a tree of this kind, bearing female flowers, at Berlin, for the fructification of which, a branch, with male flowers upon it, was once sent by post from Leipsic, (20 German miles,) and being suspended over some of the pistils, the tree afterwards yielded fruit and seed in abundance. PROFESSOR WILLDENOW has stated a very curious circumstance, concerning the *Aristolochia Clematitis*. He observes that the stamens and pistils of the flower are inclosed in its globular base, the anthers being under the stigma, which thereby requires the intervention of an insect, to convey the pollen to it. The *Tipula pennicornis* accomplishes this object; it enters the flower by its tubular part, which is thickly lined with inflected hairs, so as readily to admit the fly, but totally to prevent its release, till by the fading of the corolla the hairs have fallen flat against its sides. Hence the insect in struggling to effect its escape, brushes off the pollen and applies it to the stigma, thereby accomplishing the fertilization of the flower.

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